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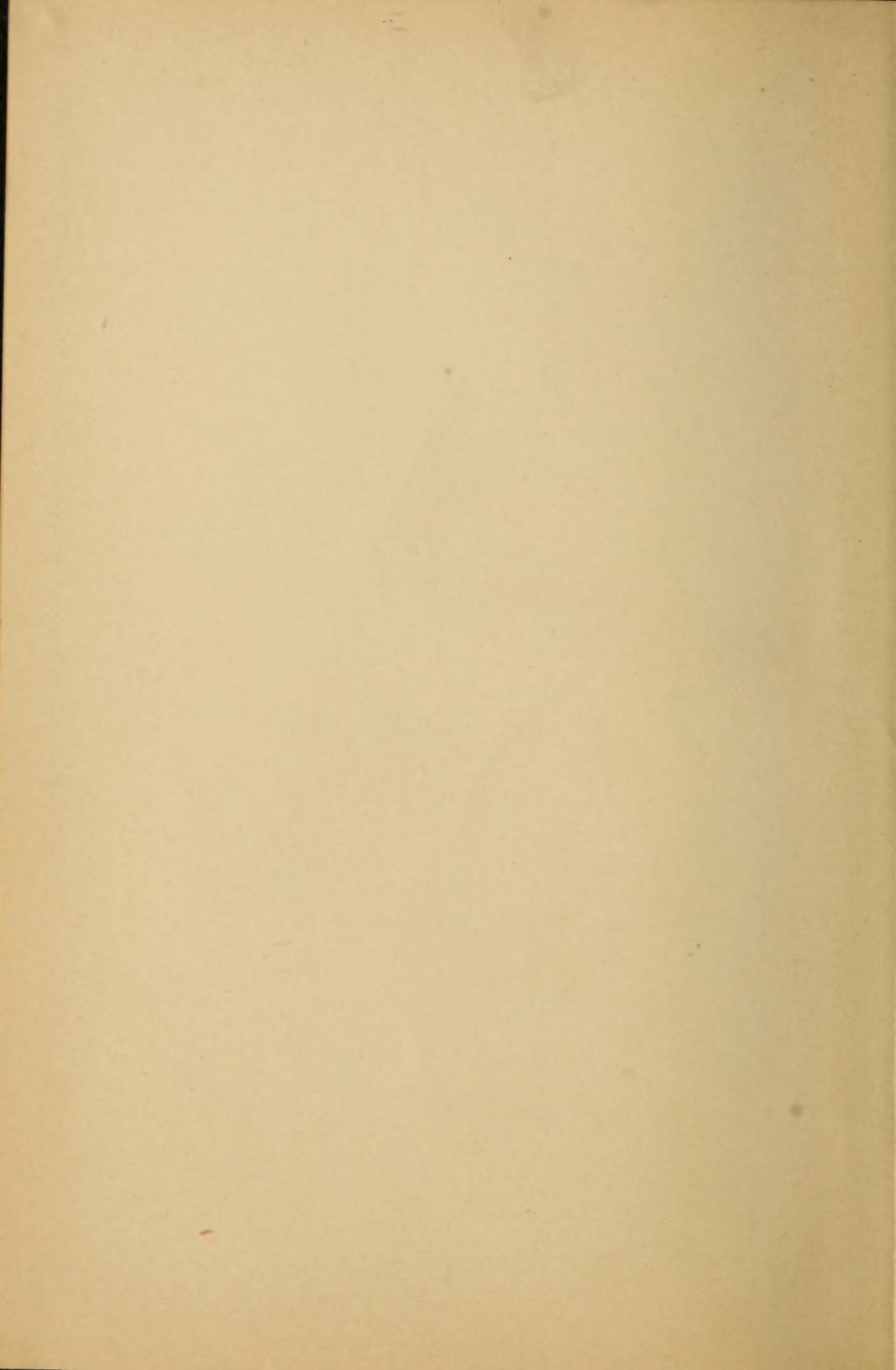
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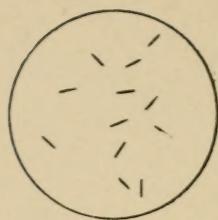
A HAND-BOOK

ON

TUBERCULOSIS AMONG CATTLE.

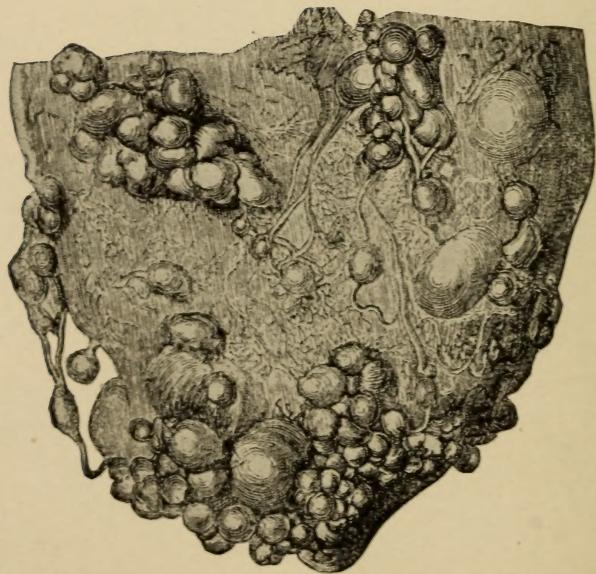






THE BACILLI TUBERCULOSIS.

(Enlarged about 4,000 times.)



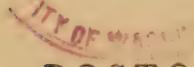
PORTION OF LUNG, WITH TUBERCLES.

A HAND-BOOK  
ON  
TUBERCULOSIS  
AMONG CATTLE,  
WITH  
CONSIDERATIONS OF THE RELATION OF THE DISEASE  
TO THE HEALTH AND LIFE OF THE HUMAN  
FAMILY, AND OF THE FACTS CONCERN-  
ING THE USE OF TUBERCULIN AS A  
DIAGNOSTIC TEST.

COMPILED BY  
HENRY L. SHUMWAY.

"The fact is, those who can, kill the bacilli however acquired ;  
those who cannot, are killed by them."

BOSTON:  
ROBERTS BROTHERS.  
1895.



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COMMONWEALTH OF MASSACHUSETTS.

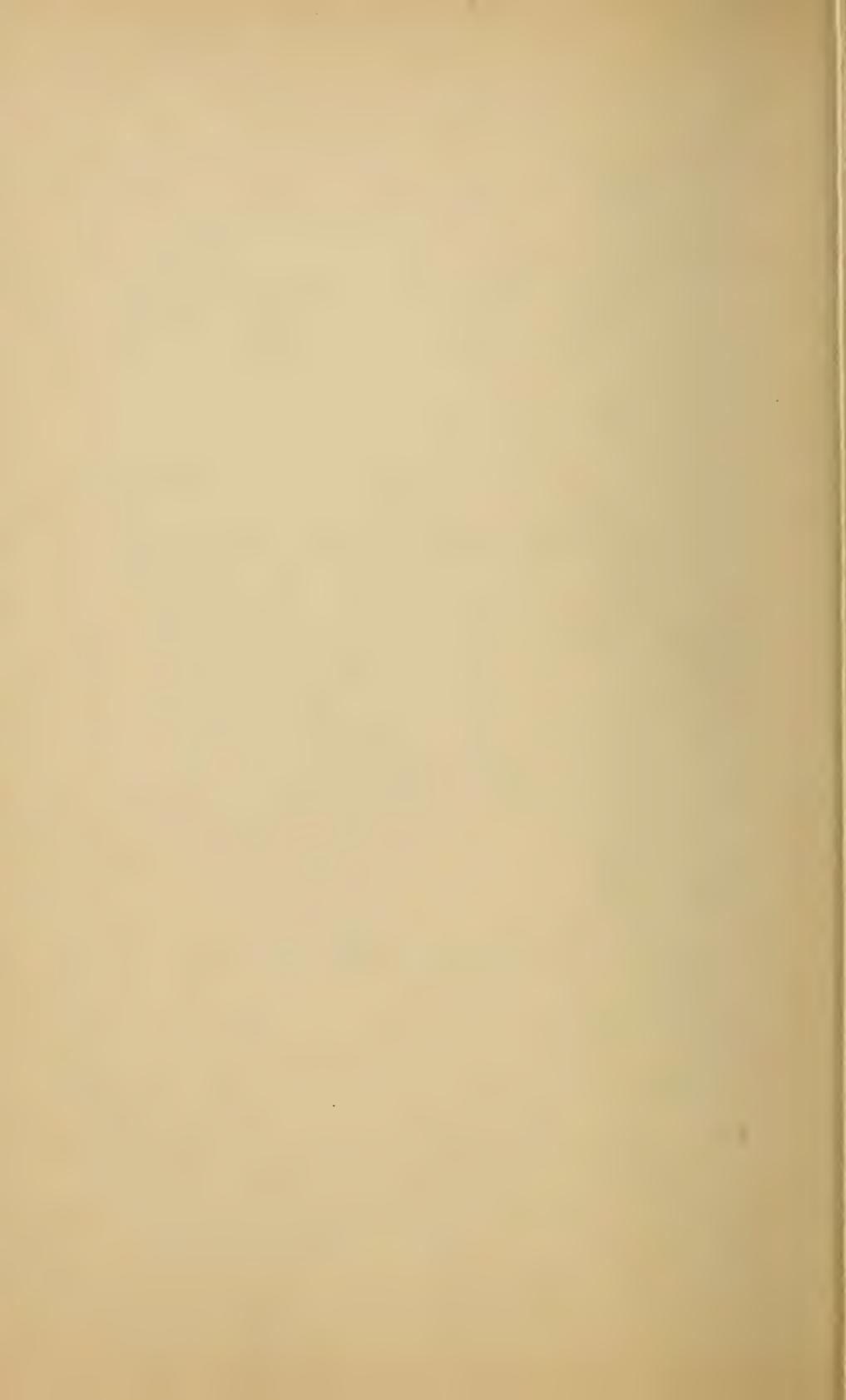
BOARD OF CATTLE COMMISSIONERS.

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52 Village St., Boston, March 4, 1895.

WE have been familiar with the work of the compiler of this volume in all its details, and can testify to the patience and care with which he has performed it. We have examined the work in manuscript, and consider it a complete, comprehensive, and candid presentation in all its phases of a subject upon which we believe the great body of the public is in need of the information he has presented.

CHARLES P. LYMAN. F. H. OSGOOD.



## P R E F A C E.

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THIS book is an evolution, its germ being an assignment to me as a member of the Boston "Herald" staff, to cover the work of the Massachusetts Cattle Commission in its attempt to control bovine tuberculosis. As I became familiar with the work, I was impressed with its importance, and with the fact that the general public had but meagre and imperfect information on the subject.

Accordingly, I attempted to gather and arrange the observations and experiences of those engaged in similar work, with the purpose of using it as a newspaper article for the better information of the public. I did not aim to instruct professional men; nor did I especially design to influence the relatively small proportion of the public who are producers of meat and dairy products. My conviction was that the great mass of consumers — the general public — had the largest interest in the matter, and to arouse their interest, and to supply them with reliable information, was my purpose.

The article was prepared and published; and it was so well received and so warmly commended by the medical and veterinary profession, that I was encouraged to enlarge and complete it for publication in a permanent form.

In doing this work I have been most cordially assisted by Drs. Frederick H. Osgood and Charles P. Lyman, of the Massachusetts Cattle Commission and the Harvard University Veterinary School; and they have been kind enough to revise and approve the matter herewith presented.

I am also under obligation to the United States Bureau of Animal Industry, and to Professor J. L. Hills of the Vermont Experiment Station, for permission to reproduce the illustrations in this volume.

THE COMPILER.

BOSTON, March 1, 1895.

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## LIST OF PRINCIPAL AUTHORITIES.

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THE principal authorities quoted in this volume, and their professional positions, are as follows:—

DR. F. H. OSGOOD, President of the Massachusetts Cattle Commission, Professor of Surgery and Superintendent of the Hospital of the Harvard University Veterinary School.

DR. C. P. LYMAN, Secretary of the Massachusetts Cattle Commission, Dean of the Harvard University Veterinary School.

DR. D. E. SALMON, Chief of the Bureau of Animal Industry, United States Department of Agriculture.

DR. HAROLD C. ERNST, Assistant Professor of Bacteriology, Harvard University Medical School.

DR. AUSTIN PETERS, a prominent Boston veterinarian, formerly Veterinary Inspector of the New York State Board of Health.

DR. BANG, Chief of the Veterinary Department of the Royal Agricultural College, Copenhagen.

MR. SENN, M. D., Ph. D., author of the standard text-book "Principles of Surgery," and member of many notable Medical and Surgical Societies.

PROFESSOR THOMAS WALLEY, M. R. C. V. S., one of the most eminent British veterinarians, Principal and Professor of Veterinary Medicine and Surgery in the Edinburgh Royal

Veterinary College, etc.; author of "The Four Bovine Scourges."

DR. GEORGE FLEMING, Principal Veterinary Surgeon of the British Army, and author of a series of standard veterinary text-books.

IRVING A. WATSON, M. D., President of the New Hampshire State Board of Health.

PROFESSOR P. H. BRYCE, M. A., M. D., Secretary of the Provincial Board of Health, Ottawa.

DR. JAMES LAW, Professor of Veterinary Science at the Cornell University Agricultural Experiment Station.

PROFESSOR J. L. HILLS, Director and Chemist, Vermont Agricultural Experiment Station.

DR. F. A. RICH, Veterinarian, Vermont Agricultural Experiment Station.

PROFESSOR J. J. MACKENZIE, Analyst of the Provincial Board of Health, Ottawa.

J. H. KELLOGG, M. D., Battle Creek (Mich.) Sanitarium.

PROFESSOR LEONARD PEARSON, of the Veterinary Department of the University of Pennsylvania.

# TUBERCULOSIS AMONG CATTLE.

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## INTRODUCTORY.

TUBERCULOSIS is not a new disease. Its existence has been recognized for ages, and its ravages have for almost an equal period been a subject of comment by statisticians, and of anxiety, observation, and experiment by the medical profession. Much, in a general way, concerning its character was long ago established ; its contagiousness was recognized, and, while until a comparatively recent period it was not differentiated from some other diseases, nor were all its varied manifestations referred to its single cause, yet its identity in man and in animals was more than suspected.

At the present time this disease is occupying a conspicuous position, not only among professional men, — physicians, veterinarians, and bacteriologists, — but among all intelligent people. Professional journals and the public press have frequent allusions to it, and there is general anxiety for information in regard to a wide variety of questions in which it is involved.

This general and increasing interest in the disease has resulted, first, from the identification by Professor Koch of the germ of the disease; second, from the confirmation of the theory that the disease is communicable between man and animals; third, from the clearer appreciation of the peril to the human family through the careless and ignorant use of meat and dairy products in which the germs of the disease are present; and, fourth, from the discovery of an agent by which its presence among animals can be declared with practical infallibility.

This last discovery, as yet hardly more than two and a half years old, has resulted in the most general increase of interest concerning the disease; for it brought with it a promise of a possible method of controlling its ravages, and relieving the human family from much of the affliction resulting from it.

Before the last mentioned discovery, while all else was practically certain, there was no means by which tuberculosis could be assuredly recognized until it had so far advanced as to place its spread beyond control, and its dissemination and steady increase were accepted as inevitable. As soon, however, as a means of practical relief was demonstrated, steps were taken at various points to apply it. The nature of the new agent was recognized as such that it was not available in the direct treatment of the disease in the human subject;

but as the disease in animals was believed to be a considerable source of human infection, its control in the animal kingdom was recognized as a most desirable end to be accomplished.

This resulted in intense activity among scientists, students, and practical men,—the end sought being full information as to the nature and effect of the disease, and a thorough test of the new agent to determine whether its claims were valid. Its value has been so far demonstrated that it has been generally accepted by the veterinary profession as a diagnostic of the disease; and the boards of agriculture and cattle commissions of several of the States have undertaken, with its aid, the control and the suppression of bovine tuberculosis.

As might be expected, the advent of a claimant for so large a measure of public confidence has been the signal for no little opposition, discussion, criticism, and misunderstanding. Conservative scientists at first contradicted and doubted its claims; but they are now, with few exceptions, its advocates and defenders, although they do not agree on some of the details of its practical application. The cattle owners, who saw in its advent a possible source of loss in the exposure of the condition and the condemnation of a portion of their herds, were at first, through what they thought was self-interest, disposed to reject its claims and resist its use. Many of these, however, recognizing that not only public duty, but their real personal

interest was involved in the prompt and certain purification of their herds, have, after examination and observation, accepted the new agent. There yet remain a few veterinarians who do not agree with the majority of their professional brethren in regard to its value, and a considerable section of the cattle owners whose fears of the consequences of its adoption control their judgment of its value; while the great masses of the public, those who as consumers of cattle and dairy products are really most interested in the purity and healthfulness of their food supply, are as yet hardly aware of the real character and importance of the discussion to which their attention is occasionally attracted.

It has been thought best to bring together for the information of this public a comprehensive and consecutive presentation of the leading features of the whole subject, which is herewith published. It has been compiled with considerable patience and care by one who has endeavored to bring together, not an argument in support of any theory, but the carefully prepared and expressed opinions of a large body of scientific men on this important subject. That these authorities agree in their main conclusions is not the fault of the compiler. They are governed by the facts that have come to them in their professional work; and that they do so fully agree is strong presumptive evidence that the professionals, rather than their lay critics, are correct in their conclusions.

## CHAPTER I.

### GENERAL PREVALENCE OF THE DISEASE.

NOTWITHSTANDING the prominence which this disease has attained in the public mind during the last two years, there is yet a very indefinite and meagre idea of its true proportions. In very many minds tuberculosis and “consumption” are considered the same, while in fact “consumption” is only one of several forms of tuberculosis. The old and indefinite term “scrofula” is more nearly a synonym; but even this fails to convey the whole truth. Cholera infantum, cerebro-spinal meningitis, convulsions in children, and nearly a score of other ailments, are all attributed to this one cause.

Dr. N. Senn says: “The frequency of tubercular affections is something appalling. At least one person out of every seven dies of some form of tuberculosis. Most of the large hospitals contain from 25 to 50 per cent of patients afflicted with this disease. The ravages of the disease are to be seen everywhere, in the shape of disfiguring scars of the neck, deformed limbs, and bent spines. Health resorts, frequented for years by tubercular patients, have become infected to such an extent

that there is great danger of the whole population becoming exterminated by this disease. The sources of infection in such places have become so numerous that it is unsafe to breathe the air, to drink the water, or to eat the food prepared in houses which for years have been hot-beds for the bacillus of tuberculosis, and by persons carrying the microbe upon every square inch of their surface. That whole communities and nations, where this disease has been prevalent for centuries, have not been completely depopulated long ago is owing to the fact that many persons possess, from the time of their birth, a degree of resistance to infection that even the direct infection by inoculation would prove harmless."

Dr. Senn also says: "That large class of ill-defined lesions which were grouped under that indefinite and vague term 'scrofula,' in the text-books of but a few years ago, have been shown by recent research to be identical with the recognized forms of tuberculosis, etiologically, clinically, and anatomically."

In another chapter he says: "It is but a few years since it was thought impossible that any other organ than the lungs should be the seat of tuberculosis. The different forms of surgical tuberculosis . . . were not correctly understood until quite recently, and consequently a rational surgical treatment was out of the question. Almost all the localized tubercular processes were included

under the general term 'scrofula,' and were regarded as local manifestations of a general dyscrasia, and treated in accordance with this view of their pathology. The discovery of the bacillus of tuberculosis has rendered the word 'scrofula' obsolete, and has assigned to the tubercular processes in the various organs and tissues of the body their correct etiological and pathological significance, and prepared the way for their successful surgical treatment. There is hardly a tissue in the body which may not become the primary seat of tubercular infection, or which escapes when diffuse dissemination occurs through the medium of the general circulation."

Professor Boyce includes in his discussion of tuberculosis the following diseases as belonging in the class: cholera infantum, cholera morbus, diarrhœa, dysentery, hydrocephalus, tabes, and phthisis.

Dr. Clark, of the Medford (Mass.) Board of Health, at a legislative hearing in 1892, said that in ten years there had been between 190 and 200 deaths from "consumption, or tuberculosis," in the town; the next greatest cause of death was "heart disease," with between 90 and 100 deaths. These designations of disease are very indefinite, but the figures show an alarming preponderance of the disease we are considering.

In a hearing before a committee of the Massachusetts Legislature, in February, 1891, Dr. Ernst said of the disease: "It is not confined, as is

popularly supposed, to the lungs. Tuberculosis of the lungs is commonly known as 'consumption'; but it occurs in all parts of the body,—as surgical tuberculosis of the joints, as tuberculosis of the membranes of the abdominal organs, as the localized skin disease called 'lupus,' which is precisely the same thing as tuberculosis occurring elsewhere, except that it is located in the skin, and as the dreaded disease called 'leprosy'; . . . for leprosy, I have little doubt, will within a short time be included under the head of tuberculosis."

Those who have most carefully considered the subject are now practically agreed that tuberculosis is by far the most fatal disease in the human family. Their opinion is thus summarized by Dr. Law:—

"Tuberculosis is equivocal and underhand in its method, slow and uncertain in its progress, and on this account escapes recognition, and proves by far the most deadly of any single disease attacking the human family. The average ratio of deaths from tuberculosis to the total mortality is 14 per cent, or one death in every eight, while under special conditions it rises to one in three. . . . But the deaths from tuberculosis being constant and uniform, people accept them as inevitable, and fold their idle hands in true Mohammedan fatalism, instead of boldly exposing the hidden death-trap, and cutting short its destructive work.

"If the 5,490 deaths from tuberculosis which occur every year in the city of New York could be

brought together in an epidemic lasting but one week, no small-pox, cholera, nor yellow-fever scare would approach the panic which would thus be created, for when did all those diseases create such mortality in this city? Nay, if we take the whole civilized world, and compare with the tuberculosis mortality all the accumulated deaths from war, plague, cholera, yellow-fever, and small-pox, we find that the latter are comparatively very insignificant. Yet tuberculosis, like every germ-disease, is absolutely preventable, and is allowed to continue its career of death only because of reprehensible, ignorant, and criminal indifference."

Professor Hills and Dr. Rich say: "When conditions have favored its spread, the death-rate from tuberculosis has been as high as 50 per cent of all mortalities. Many of the fatal bowel troubles of infants have their origin in tubercular infection. An article in the 'Archives de Médecine' says that 'of the population of the globe three millions die annually of consumption.' "

Dr. Abbott, at a hearing before a Massachusetts legislative committee, stated the annual number of deaths per 10,000 inhabitants in that State from tuberculosis to be, from 1870 to 1879, 33.4; from 1880 to 1889 it was 29.7. Of the apparent decrease he said: "I do not, and I think that the physicians generally do not, take that as an indication that the causes of consumption or tuberculosis are less prevalent than formerly. I do think that the intelligence of the people as to the promotion of consumption,

and that it is an infectious disease, is one of the explanations of this variation."

Dr. Lagneau, a noted French authority, compiled the statistics of 662 localities in France, to show that the more dense the population the more prevalent is tuberculosis. The per cent who die annually from tubercular phthisis to every one thousand inhabitants appears as follows:—

Ninety-five cities, with less than 5,000 inhabitants, 1.81. Three hundred and thirty-two cities, with between 5,000 and 10,000 inhabitants, 2.16. One hundred and twenty-seven cities, with between 10,000 and 20,000 inhabitants, 2.71. Fifty cities, with between 20,000 and 30,000 inhabitants, 2.88. Forty-six cities, with between 30,000 and 100,000 inhabitants, 3.05. Eleven cities, with between 100,000 and 430,000 inhabitants, 3.63. Paris, with 2,424,703 inhabitants, 4.90.

Lehmann, of Copenhagen, gives as the results of the total deaths in that city for a period of twenty years, from revised death certificates, the following as the per cent of deaths from tuberculosis at different ages, with sex division:—

Age.	Male.	Female.
1 to 5 years . . . . .	1.83	1.97
5 to 10 " . . . . .	10.36	11.97
10 to 15 " . . . . .	15.53	32.03
15 to 20 " . . . . .	37.4	42.68
20 to 25 " . . . . .	35.5	33.1
25 to 35 " . . . . .	41.5	33.6
35 to 45 " . . . . .	31.7	29.9
45 to 55 " . . . . .	29.9	23.8

He remarks, in commenting on his tables, that in the female sex from fifteen to forty-five years of age, every third person died of tuberculosis.

Wahl of Essen furnishes similar tables from that city, showing the per cent of total deaths resulting from tuberculosis as follows: to 5 years of age, 3.7 per cent; 6 to 20 years, 23.1; 21 to 40 years, 35.1; 40 to 60 years, 34.7; over 60 years, 12.8. The average for all ages is 15 per cent.

Dr. Salmon writes of the history of the disease that it has been known for many centuries, and legislative enactments having reference to the destruction of affected animals, and forbidding the use of the flesh, date far back into the Middle Ages. He says: "The opinions entertained regarding the nature and cause of the malady varied much in different periods, and very markedly influenced the laws and regulations in vogue. Thus, in the sixteenth century, the disease was considered identical with syphilis in man. In consequence of this belief very stringent laws were enacted, which made the destruction of tuberculous cattle compulsory. In the eighteenth century this erroneous conception of the nature of the disease was abandoned, and all restrictions against the use of meat were removed. Since that time, however, the tide of opinion has again turned against the disease."

The Vermont Experiment Station Bulletin defines tuberculosis as a general name for a class of diseases which attack various organs, and which

both man and animals readily contract. It states that the human death-rate from the disease in its numerous forms is one in four of the total, and that its extent among cattle cannot be accurately stated, owing to a lack of systematic inspection.

Professor Walley writes: "Tubercle is a visible local manifestation of a constitutional diathesis, 'scrofulosis.' While this proposition is in the main correct, it must not be assumed that tubercle does not originate independently of the constitutional condition known as 'scrofulosis.' From a variety of causes, or rather from a concatenation of circumstances (not yet distinctly understood), tubercular inflammation may be established, and the usual local manifestation (tubercle) be produced; and in different ways tuberculosis can be originated in the systems of animals in which not a trace of scrofula is to be discovered."

Of the gravity of the disease, Professor Walley says: "Looking at an individual tubercle, we might be led to despise its comparative insignificance, and to ignore its deadly meaning; but when we see thousands upon thousands of these knots existing in the organism of a single animal, a truth is forced upon our minds which we cannot refuse to recognize,—namely, that we have to deal with an insidious, implacable, and deadly foe. And, independently of its ultimate fatality, I think I may with safety reiterate what I have before asserted, that no morbid substance known to the pathologist is so

protean as tubercle in the number of functional derangements to which it gives rise. . . . He does not take into account the vast deterioration, the slow but certain decimation of many of our best herds, the destruction of human food, the danger — not, as it is now proved, chimerical or hypothetical — to human life and human comfort, and the insidious progress of that fell destroyer, tubercle. The other three bovine scourges sweep their victims off in a manner which is seen by all ; but the ravages of tubercle are only realized by those whose duties are connected with the public abattoirs, or who are called upon to act as arbiters on the nature of disease.” It is a sad commentary on the above that within a few weeks, and after it was copied from his work, Professor Walley himself has died from the disease, acquired three years ago by inoculation in connection with his profession.

The frequent failure of proper diagnosis, and the carelessness with which death-returns are often made up, seriously complicate any attempt to definitely show the real prevalence of this disease. It appears in numerous and varied forms in the human subject ; and while a physician might be aware that they were all referable to tuberculosis, the general public has no knowledge that even suggests this fact. The list of locations of the disease in the animal body, elsewhere given, suggests something of the carelessness that is possible in defining the disease.

In a recent discussion by the Massachusetts Association of Boards of Health, the matter of death-certificates was discussed, and there was general agreement of opinion that there is much need of a greater degree of accuracy. Dr. William Y. Fox, of Taunton, presented statistics showing that in his city, from 1889 to 1893 (four years), there were defective certificates in about 22 per cent of the entire record. That Taunton is not alone in this direction he showed by citing other returns, from which it appeared that in 1893 Haverhill had 14 per cent of worthless certificates, Worcester had 12 per cent, Woburn 15 per cent, Lawrence 18 per cent, Newton 11 per cent, Marlborough 14 per cent, and New Bedford 19 per cent. It is quite clear that the public will remain ignorant of the real extent of the effect of tuberculosis until its numerous and varied forms of manifestation are better known through increased attention to correct diagnosis, and through general education on the subject.

## CHAPTER II.

### THE DISEASE IN THE LOWER ANIMALS.

EXPERIMENTS carefully made and widely observed show that tuberculosis affects a far wider range of animals than any other disease. Horses and sheep are popularly supposed to be free from infection, under ordinary conditions, but they can readily receive it by inoculation.

On the other hand, fowls, cats, guinea-pigs, rabbits, swine, and neat cattle are very susceptible to the disease, either by natural or artificial infection. While nearly all domestic animals may take on and impart the disease, fowls, swine, and cattle are recognized as most dangerous, from their favorable conditions for its dissemination.

Until the discovery, in 1891, of the efficacy of tuberculin as a detective of the disease, there was no possibility of ascertaining to what degree it prevailed in live animals. The statistics from the slaughtering establishments are of little value, because of the varying regulations in different countries. Reports from European countries represent a wide range,—Baden showing only 2 per cent of disease found at the abattoirs, while France reports

5 per cent. On the other hand, Paris reports 6 per cent, Holland 20 per cent, Pomerania 50 per cent, and Hanover 60 to 70 per cent. Such variations cannot be due to differing conditions so much as to local regulations and inspection requirements.

Professor Hills and Dr. Rich, after alluding to the conditions which make it impossible to secure positive data on this subject, say: —

“ Probably many of the estimates given by various authors are based on faulty or insufficient data. The following examples may serve to some extent to indicate its prevalence. The extremes are wide, being from 2 per cent (among 2,273,547 cattle, mostly steers killed in the meat inspection districts of the United States from May 15, 1891, to March 1, 1892) to 60 or 70 per cent (at Hilderstein, Hanover, according to Haarstick). In a large number of German abattoirs it is stated that 6.9 per cent of the cows, 3.6 per cent of the steers, 2.6 per cent of the bulls, and 1 per cent of the young stock were tuberculous. Of 1,270,604 animals slaughtered in German abattoirs from October, 1888, to October, 1889, 26,352, or 2 per cent, were tuberculous. Careful post-mortems by skilled veterinarians showed 12 per cent of tuberculous animals out of 12,000 slaughtered in England as affected or exposed to contagious pleuro-pneumonia (a disease entirely distinct from tuberculosis). In seventeen counties in New York State the inspectors of the State Board of Health found 3.4 per cent of tuberculous cattle out of

20,000 inspected. Cattle slaughtered at Baltimore were found tuberculous to the extent of from 2.5 per cent to 3.5 per cent, while of 1,153 cattle from the Eastern States (mainly New England), slaughtered at Brighton, Mass., 52, or 4.5 per cent, were tuberculous. Doctors Salmon and Smith state that 'it is not far from the truth to assume . . . that one of every fifty head of cattle in the more densely populated areas of Europe and America is tuberculous.' Dr. Salmon states yet later, however, that 'the ideas in regard to the prevalence of tuberculosis have been radically changed by the facts brought out in using tuberculin.' "

As long ago as 1890 it was determined that 4.5 per cent of cattle slaughtered at Berlin were tuberculous, while one abattoir in Upper Silesia reported 9.5 per cent.

Professor J. J. Mackenzie, in discussing tuberculosis in a paper printed in 1892, said: "That the disease is common in cattle needs no specific proof from me. We may accept it as more than probable that in ordinary milch cows in the provinces [Dominion of Canada] the percentage of animals affected may reach six per cent: that, at any rate, has been shown to be the case in countries where exact data have been obtained. In the expensive in-bred stock, such as the Jerseys, the percentage is higher,—so high in fact that it is very startling to think of."

The chief of the Bureau of Animal Industry for

Maryland reports that of cows killed for beef in the Baltimore slaughter-houses about 3.1 per cent proved tuberculous. In six months, so long ago as 1889, he inspected 122 stables supplying milk to Baltimore, with 1,611 cows, and found 11.3 per cent to be badly tuberculous. This was by physical examination only; later experience with tuberculin suggests that its use then and there would have revealed a far more serious condition of affairs.

The experience of the Massachusetts Commission in the work brought to them through the local inspectors in cities and towns indicates a much wider prevalence of the disease than appears at Nantucket. The local inspectors are required to examine all the cattle in their districts twice each year, and to report all cases suspected of tuberculosis to the Commission. All cases thus reported are tested with tuberculin by the expert agents of the board. Under this system some large herds have been almost entirely destroyed. In each of two herds, one near Boston and the other in the Connecticut River valley, of 65 animals each, 60 were killed from each herd, and all showed the disease on autopsy. In several other large herds fully one half were taken. In this department of their work the Massachusetts Commission has found nearly all the animals condemned to show the disease in very pronounced and advanced forms.

In connection with the report of Professor Ernst and Dr. Peters to the Massachusetts Society for

Promoting Agriculture, of their work in investigating the transmission of tuberculosis by means of milk, the latter gentleman especially discusses the prevalence of bovine tuberculosis. He quotes Fleming's Manual of Veterinary Sanitary Science or Police: "Tubercular phthisis, or tuberculosis, probably prevails among the domesticated animals over the entire globe, though its frequency will depend upon various external influences, as well as the constitutional tendencies of different species and breeds. . . . In Europe, particularly in the cow-sheds of the larger towns and cities, it is extensively prevalent, and in this country [England] it has long been recognized as a common disorder among animals, but more especially as affecting the bovine species."

Professor Walley counts contagious pleuro-pneumonia, rinderpest, foot-and-mouth disease, and tuberculosis as the "four great bovine scourges," and Dr. Peters says the last named is the only one "staring us in the face, and challenging us to combat, if we are not afraid to grapple with it."

In connection with his work, Dr. Peters sent out about 350 circulars to veterinarians in various parts of the United States, asking as to the frequency or infrequency of tuberculosis in their practice. Only 79 replies were received. Of these, 21 had no cattle practice, 19 reported "no cases," and only 39 reported any contact with the disease. From the last class, in seventeen different States, most of

them reporting for one year only, 549 cases were reported, with 242 suspicious cases,—a total of 791 in 165 herds containing about 3,000 animals; that is, where the disease existed, about 18 per cent were diseased, with 8 per cent suspicious,—a total of 26 per cent. It should be borne in mind that all these reports were based only upon physical examination. What would be the result if tuberculin were applied to these herds, is a matter for grave consideration.

The New York State Commission on Tuberculosis in Cattle, in their report to the Legislature, January, 1895, say: "During the short time since its creation this Commission has carefully studied, by a system of special inspection, the prevalence, distribution, mode of infection, and general behavior of tuberculosis in cattle, confining part of its work to a given area which was thought to be comparatively free from general infection from other sources. In this district 947 animals were examined, and out of this number 66 were condemned and slaughtered. A dissection of each animal showed it to be tuberculous, showing 6.96 per cent diseased; and it is believed that this is a fair average if the State were taken as a whole.) A large proportion of these animals were common stock, which fact controverts the opinion, which obtained very generally hitherto, that common bovine animals have immunity from tuberculosis. Tuberculosis is not a respecter of breeds. The

disease once introduced into a herd spreads with certainty throughout, and with a rapidity proportionate to the unsanitary surroundings. Cattle kept in well-ventilated stables, with free admission of sunlight, are less prone to the disease, while those kept in dark, ill-ventilated stables, amid filth and unsanitary environments, develop the disease rapidly, once it is introduced."

Dr. J. F. Winchester, of Lawrence, Mass., a veterinarian, and in 1888 a member of the State Cattle Commission, collected all attainable information on the prevalence of the disease in this State. In the report of the Board of that year, his results are given, showing that reports from thirty-four farms, with 886 animals, showed 243 animals, or 28 per cent, killed as diseased, and 189 animals, or 21.33 per cent, "suspicious." On fifteen other farms, with 244 animals, he found over 11 per cent by physical examination showing symptoms of the disease, beside 10 per cent "suspicious."

The Tuberculosis Committee at the Veterinary Congress of America, in connection with the Chicago Exposition, 1893, in discussing the indefiniteness of statistics of the disease, said: "We have no regular inspection of herds nor a complete inspection of meat. It is only possible to glean facts relating to the extent and distribution of the disease incidentally, when cattle are examined with other ends in view. Even if we had an organized inspection of herds, the result of such an inspection

would not teach us how much tuberculosis is present among our cattle, because the disease is notoriously hard to discover in the living animal, except when advanced; and breeders and farmers who have had some experience with it are clever enough to remove animals that show the first suspicious symptoms. It is only by an extensive examination with tuberculin, or a thorough and well-organized system of meat inspection, that reliable statistics can be obtained."

This committee, in discussing the dangers from the disease, place its transmission through the meat and milk to man as first, and its transmission among cattle as second in importance.

Occasionally the statement appears that there is less of tuberculosis, human or bovine, now than there was a score or two of years ago. That this is a superficial and unfounded idea appears from the fact that Professor Walley, in 1874, quoted the Veterinary Record of 1847, in its allusion to a case of tumors of bovine tuberculosis as "similar to some we have occasionally seen," and saying, "On this subject our English veterinary authors are silent, and we believe the above to be the only case of the kind recorded." That the post-mortem appearances of the disease were unknown to English veterinaries of half a century ago argues that the disease itself was practically unrecognized. It is also true that at no very remote time medical men made no distinction between syphilis and tuberculosis; and

it is less than a quarter of a century since glanders and tuberculosis were considered the same disease. Professor Walley committed himself to this statement in 1872. These facts justify the conclusion that there are no statistics covering any considerable period that are of any value as a basis of comparison as to the prevalence of the disease.

Bulletin No. 27 of the Hatch Experiment Station of the Massachusetts Agricultural College, issued in December, 1894, gives a history of tuberculosis in the College herd, from which it appears that even at this presumably well-informed institution, in the year 1871, a well-defined case of the disease failed of recognition. On post-mortem examination, "it was found that the pleural surface of the thorax was thickly studded with large and small nodular growths, some of which were filled with pus and others with caseous or calcareous material. The true nature of these excrescences was not recognized. No one even suspected that they were the result of disease, but regarded them as an abnormal growth and a curiosity."

Two years later another animal died, of which the Annual Report says: "The disease was a most obscure one; but her trachea, lungs, liver, pleura, and whole thoracic cavity, were affected with a morbid growth, apparently of a scirrhous nature. . . . In this connection I may mention that by many cow-doctors the symptoms were referred to horn-ail; and it was only with the greatest difficulty

that I prevented the most zealous from boring the suffering creature's horns and stuffing them with cayenne pepper, spirits of turpentine, and other soothing preparations." In the Report of 1874 this case is identified as tuberculosis.

That such clear illustrations of the disease could fail of identification in such an institution is suggestive of the denser ignorance which must have pervaded the public at that time, and which unfortunately is not yet entirely dissipated.

The limitation of tuberculosis to pulmonary consumption is still a popular error, and not a few medical men still fail, in their returns of death causes, to recognize the full list of diseases that are tuberculous. On the other hand, modern classification is tending to closer differentiation, as several classes of cases once entered as "consumption" now appear under newer names. It is therefore extremely difficult to make a fair comparison of statistics so as to determine with any certainty whether tuberculosis is or is not on the decrease in the human race.

Those writers who admit that the disease has thus decreased, find an explanation of this in the increased attention paid to sanitation under the influence of modern boards of health, and especially in the present general recognition of the infectiousness of the disease, and the consequent practicability of controlling it by preventive measures.

## CHAPTER III.

### ITS VARIED SYMPTOMS AND APPEARANCES.

THE slower progress of tuberculosis as compared with other infectious diseases has aided in the general indifference with which it has been regarded. In its acute form it often runs its course in a few weeks, but its usual manifestation is of a chronic and dilatory character, often lasting for years.

The disease attacks many of the organs of the body, and it often makes considerable progress in one organ before others are involved. This results in great difficulty in recognizing its presence in its earlier stages, or in identifying it where some difficulty or disease is indicated. Often the disease is well established before any noticeable indication is seen, and as often the symptoms are so varied, as one or another organ is affected, that there can be no certainty of recognizing it.

Cases are frequent where the animal appears to be in excellent condition in every way, and on autopsy extensive and long-seated disease of some one or more organs is exposed. In one case a Boston merchant with a thoroughbred herd of one hundred animals suspected the presence of tuber-

culosis, and employed a veterinarian to apply the tuberculin test. He had exercised his own best judgment, after twenty years of close study of his herd, in the selection of two young cows which he felt sure were free from the disease, and these he had set aside to supply his own family with milk and butter. He was confounded when the tuberculin test pronounced these two animals diseased, and could hardly accept the verdict; but when they were killed, with thirteen others, and the autopsy showed them the worst diseased animals in the herd, his astonishment was equalled only by his distress over the peril to which he had unwittingly exposed his family. This is but one of several similar cases that have occurred in the work of the Massachusetts Cattle Commission.

On the other hand, cases are of frequent occurrence where careful and experienced owners and the best veterinarians have examined animals that were badly out of condition and might well have been killed on general principles, and have felt sure that they were affected by tuberculosis, even when tuberculin said they were not, but found their opinion contradicted by the facts at the autopsy, no traces of the disease being discernible.

Such experiences confirm the general opinion of all experts, that physical examination alone really counts for but little in the discovery of the disease. If physical examination was alone available, the

task of eradicating or even of controlling the disease would be a hopeless one.

Especially where the disease attacks the lymphatic glands, its recognition by physical examination is very uncertain, and is certainly much delayed. The affection of the bronchial and mediastinal glands lying between the lungs, and of the mesenteric glands amid the involutions of the intestines, is similarly concealed and of doubtful detection. And, besides, these glands are subject to other diseases of less dangerous character; so that, if disease is recognized there, its true character cannot be declared.

In acute cases, and in chronic cases where the disease involves a large portion of the internal organs, there is usually a feverish condition, loss of flesh, sinking and dulness of the eye, roughness of the coat, rigidity of the skin, and other attendant symptoms of illness; but all these may be present without tuberculosis. They are sure symptoms of illness, but they make no certain declaration of its character.

It is a popular, but an unfounded notion, that this disease is only of the lungs, and that a cough is its only certain indication. That the disease is far more varied in its location has already been stated. That a cough is the certain indication of the disease in cattle, even when the lungs are affected, is also a delusion. All cattle cough more or less when in health, and an observer needs far

more than ordinary training to determine with any certainty the difference between a normal cough and the cough of tuberculosis.

The tuberculous cough is described as small, dry, and wheezing, or rattling, and may be expected to follow the drinking of cold water, or unusually violent exercise. A trained observer may sometimes detect the disease, if it is located in the lungs, by tapping on or listening on the walls of the chest; but the anatomy of the animal, the frequent and varying sounds in the stomach and bowels, and the pressure of these when distended against the lungs by their contents, so complicate the sounds that no certain conclusion can be reached by these means. The fact that in tuberculosis the disease often scatters itself in small masses throughout the whole lung tissue, while most other lung diseases involve large masses and finally the whole structure, renders the sounding of the lungs but an uncertain test. Often the nodules are found scattered through the lungs like plums in a pudding, when no information could be secured by tapping or listening.

In advanced cases, where the lungs or the glands of the throat are involved, the breathing is sometimes labored, and there is an offensive discharge from the nostrils. When the disease is general throughout the body the animal may curl and writhe, and perhaps cough or groan, if the back is strongly pinched over the shoulders or loins, or above the breast-bone, or if the ribs are struck sharply by the fist.

Dr. Law says: "In the advanced stages of lung tuberculosis any one can recognize the consumptive animal. It is miserably poor, and wastes visibly day by day; the dry coat of hair stands erect; the harsh, scurfy skin clings tightly to the bones; the pale eyes are sunken in the sockets, tears run down the cheeks; yellowish, granular, fetid, and often gritty discharges flow from the nose; the breathing is hurried and catching, the breath fetid; the cough is weak, painful, and easily roused by pinching the back or breast, or striking the ribs. Temperature may vary from below normal, 101, to 107 degrees Fahrenheit."

In sucking calves, tuberculosis, if received in the milk, shows itself in bowel troubles, with enlargement of the intestinal glands and their filling up with the tuberculous deposits. In mature animals, when the disease attacks the digestive apparatus its especial symptoms are capricious appetite, bloating, scouring, costiveness, colic, and even more emaciation than when the lungs alone are involved. The temperature usually increases as the disease progresses in activity.

When the disease is well established in the sexual organs there is abnormal excitement. The cow is frequently in heat, but fails to conceive. There is often a whitish discharge from the vulva, and elevated temperature is frequently observed. The liver is often one of the early seats of infection, and the attendant symptoms are quite like those where the

bowels are affected. When the kidneys and bladder are involved there is tenderness of the loins, which may be detected by pinching. There is also, in some cases, frequent urination, and the fluid sometimes shows traces of blood, or of purulent matter.

The glands of the throat are often the first seat of the disease, the infection coming from inhaling or swallowing the dry bacilli floating in the atmosphere. There is a wheezy sound in breathing, and the glands at the base of the tongue and along the throat are enlarged, those on one side usually more than on the other. They may be reduced in size, and much harder than normal, or soft and yielding if handled. A loose cough sometimes attends the throat trouble, with difficult swallowing and a discharge of slime from the mouth. When the tubercles are located in small masses along the lining of the throat and air passages, there is a harsh and spasmodic cough. When the lungs are first infected it often occurs that the bacilli pass to the mouth with the sputum, and from there are swallowed to infect the intestines.

The udder is usually attacked one quarter at a time, with swelling which may involve the whole gland. The lymphatic glands in the front and rear of the udder are much enlarged and hardened, so as to be readily felt on examination. In some cases the milk shrinks in amount, and is thin and watery; but often the disease advances until the whole udder is infiltrated with the products of the disease before any reduction in the amount of milk is observed.

There is a small gland in front of each shoulder-blade in a cow, which is often sought for in judging of her milking quality. This is frequently affected, and its enlargement and undue hardness may be easily felt, especially in thin cattle. A similar gland in front of the stifle, which is likewise sought for by the buyer, may also disclose the presence of the disease by its enlargement. Glands on the sides of the udder, and those at the lower part of the channel containing the jugular vein, have similar manifestations. There is occasional manifestation of the disease about the stifle and hock joints, with hard enlargements, causing lameness. In extreme cases the bone is so diseased as to crumble, and expose itself through the skin.

Although the foregoing presents a formidable array of symptoms, supposedly easily recognized, it must be remembered that all are rarely present in a single case; and usually each is so masked, or so characteristic of some other ailment, as to confuse and confound even the expert veterinarian. Beside, it must be remembered that the affection of one organ with the disease sooner or later leads to the affection of others. Thus the expectorations from diseased lungs, rising to the mouth, may pass into the stomach and bowels, and these, being affected, send the disease to every other organ by means of the circulation.

Professor Walley recognized the difficulty of determining the presence of tuberculosis by physical

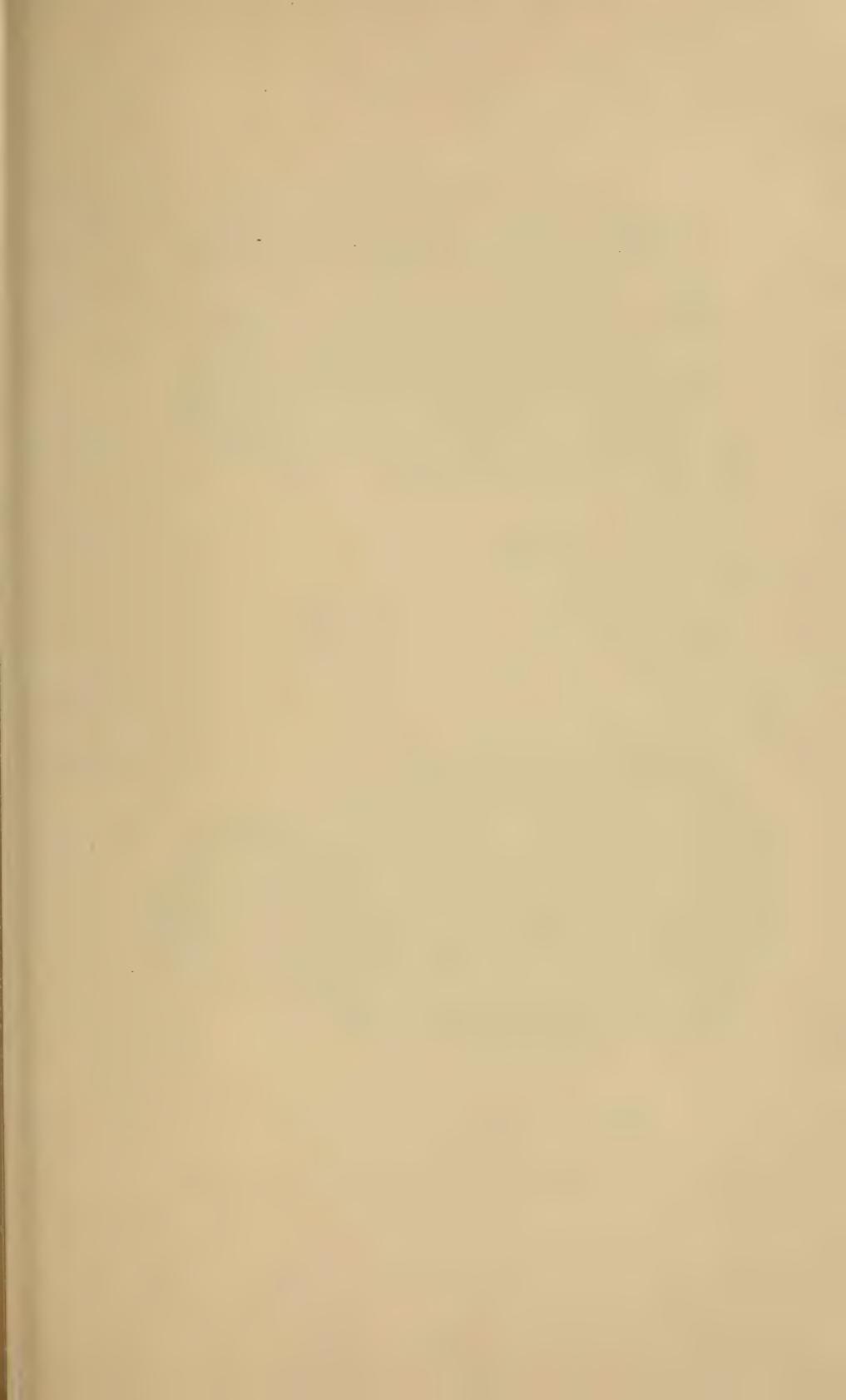
examination. In 1879 he wrote: "Acute tubercular disease of an organ may give rise to no symptoms of a positive character. Particularly would this be so in the case of an organ having no external outlet; and even where one exists, it would be of far less aid to us in acute than it would in chronic disease. In acute hepar tuberculosis, for instance, there might be no symptom which would not be equally present in acute hepatitis from any cause; so in acute pulmonary, renal, or intestinal tubercle, nor either in acute or chronic, should we have any symptoms to guide us, where the disease is confined to the internal lymphatic glands. In chronic tuberculosis of organs having an external outlet there is always just the possibility of our being able to detect, by patient ocular and microscopical examination, tubercular elements in the secretions or excretions."

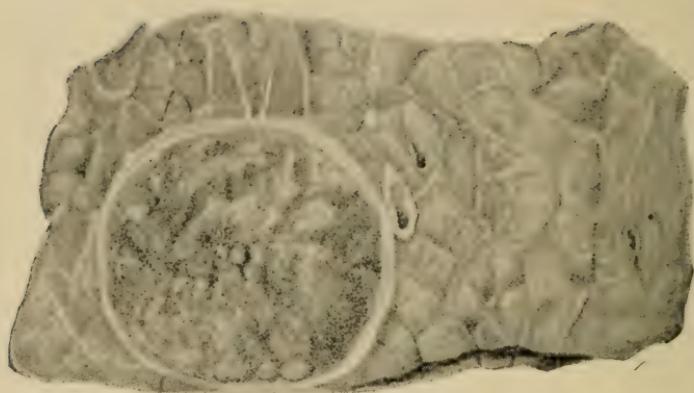
Of the difficulty of diagnosing the disease in its pulmonary form, Professor Walley says: "Perhaps there is no form of tuberculosis which is more likely to be confounded with other affections than this; and the reason is not far to seek. It is simply that so many pathological conditions, totally different in themselves, give rise to the same physical lung symptoms and general constitutional indications." It will be generally conceded that, if the difficulty of diagnosis is so great when the disease is located in the lungs, where its appearance is most apparent to the general observer, there is but little

hope of a correct diagnosis by physical examination when it is located in other and less accessible organs.

Professor Hills and Dr. Rich, after full consideration in preparing their bulletin on the disease, decided that the symptoms are so obscure and variable, except in advanced stages, that it was inadvisable and would be misleading to attempt to give a further description of the symptoms than the following, which is from the special report of the Bureau of Animal Industry of the United States Department of Agriculture on "Diseases of Cattle Feeding": "A dry, short, interrupted, hoarse cough, which the sick animals manifest in the morning at feeding-time, and still more after somewhat violent exertion. At first these animals may be full-blooded, and lay on a considerable amount of fat when well fed. As the disease progresses, they grow thin, and show more and more those appearances which indicate diseased nutrition, such as staring, lustreless eyes, dishevelled coat, dirty, tense skin, which appears very pale in those regions free from hair. The temperature of the skin is below normal. The loss of fat causes sinking of the eyes in their sockets; they appear swimming in water, and their expression is weak. The cough is more frequent, but never or very rarely accompanied with a discharge. The body continues to emaciate even with plenty of food and a good appetite, so that the quantity of milk is small. At times in the

early stages of the disease, still more in the later stages, the diseased animals manifest considerable tenderness when pressure is applied to the front or sides of the chest, by coughing, moaning, etc. Often all symptoms are wanting, in spite of the existence of the disease.”





#### TUBERCULOSIS OF THE LUNGS.

(The two cuts show different stages in the growth of the tubercles.)

## CHAPTER IV.

### POST-MORTEM REVELATIONS.

THAT the impossibility of the diagnosis of this disease by physical examination is not an invention of those who are advocating the use of tuberculin may be seen from the declarations of Monsieur Van Hertsen, chief inspector of the Brussels abattoir; Dr. George Fleming, principal veterinary inspector of the British army; and Herr Lydtin, principal veterinary surgeon of the Grand Duchy of Baden, who, in a report prepared for discussion at the International Veterinary Congress at Brussels, in September, 1883, wrote as follows:—

“ Taking all the circumstances into consideration, we need not be astonished at the numerous voids that still remain in the symptomatology of tuberculosis; and it can easily be understood that the diagnosis of the disease is looked upon as very difficult, and often even impossible. Certainly the difficulties in the way of diagnosis are real; they are the consequence, in many cases, of the slow and insidious course of the disease, which sometimes lasts for years, and the phenomena of which often pass unperceived. And, besides, as the mor-

bid products of the malady may in certain cases be deposited in organs which under ordinary conditions would remain free from them, (as in the brain, spinal cord, kidneys, and genital organs,) and produce special manifestations, it is scarcely possible to trace in a precise and definite manner all the symptoms which mark the presence of the disease in every case."

The same gentlemen also report the various locations of the disease as follows. In the lymphatic glands of the head, neck, and chest; the cervical maxillary, sub-maxillary, prescapular, parietal and thoracic glands; mediastinal and bronchial glands; the lungs; the pleura; the peritoneum; the mucous membrane of the larynx, pharynx, trachea, and oesophagus; the brain and spinal cord; the skin of the forehead; the mesenteric glands; the omentum; the intestinal mucous membranes; the liver, spleen, and kidneys; the coats of the bladder, the vaginal sheath, the testicle, the spermatic cord, the prostate gland, the uterus, the fallopian tubes, and the ovaries; the udder; the cardiac muscle; the muscles of the body, and the bones and the articulations. So formidable a list needs no comment to suggest the unscientific character of the idea that tuberculosis is only a lung disease. They mention, as exceptional phenomena of the disease, a bovine uterus weighing three and a half hundred-weight, and a tumor on the heart of an ox weighing twenty-seven pounds.

From the writer's observation of several hundred autopsies in the autumn of 1894 and the winter of 1894-95, the following indications are gathered as substantially all that may ordinarily be expected to appear.

The establishment of the disease in any organ of the body is usually in the form of a lesion, or colonization and multiplication of the bacilli, resulting in a rounded nodule, which is called a tubercle; but this formation is sometimes absent, and a diffused permeation of the tissues by the bacilli results in only a thickening of the infected part.

The tubercle or nodule is at first only of microscopic size; but its earliest readily visible appearance is in size like a millet seed, from which this stage of the disease is called "milliary." These tubercles soon accumulate in masses, and gradually change from a red or congested condition to yellowish gray cheesy masses, in which gritty particles of lime salts are present; and as the disease progresses these sometimes are resolved into semi-fluid masses of yellowish pus or matter. All these stages may be found in a single animal, or only one may be found in a single organ. Frequently the cheesy mass, instead of developing into the pus stage, forms firm and fibrous nodules, which hang in clusters from the lungs, or adhere on the walls of the chest and abdomen. This form is known among butchers as "pearl disease" or "grapes."

The thoracic, bronchial, and mediastinal glands

of the lower throat between the lungs, the mesenteric glands within the involutions of the intestines, and the glands connected with the udder, are often greatly enlarged,—from the size of a bean to the size of a man's fist, or larger, and filled with a cheesy mass of dead tubercle, or with semi-fluid pus.

In discussing the disclosures at sixty autopsies, Bulletin No. 7 of the Bureau of Animal Industry comments on the high percentage of infection in the herd in which not more than five or six showed physical indications of disease, and says: "The concealed character of the disease was not always limited to the very mild infections, but in some cases considerable lung disease remained unobserved during life. Of the sixty animals killed only seven, or about 12 per cent, were free from all traces of tuberculosis."

A summary of the disease in this herd, as disclosed by a thorough examination of the head, thorax, abdomen, and the glands of the lungs only, is given as follows:—

Total number in the herd . . . . .	60
"    "    infected . . . . .	53
Retropharyngeal glands affected . . . . .	9
"    "    "    only affected . . . . .	5
Thoracic organs affected . . . . .	47
Lungs affected . . . . .	20
Thoracic glands, but not lungs, affected . . . . .	27
Bronchial glands only affected . . . . .	5
Mediastinal glands only affected . . . . .	5

Lungs diseased and glands healthy . . . . .	1
Exclusively thoracic lesions (air infection) . . . . .	26
Digestive tract and head-glands affected . . . . .	26
Intestinal walls affected . . . . .	1
Mesenteric glands affected . . . . .	16
Portal glands affected . . . . .	10
Mesenteric but not portal affected . . . . .	10
Portal and not mesenteric affected . . . . .	4
Parenchyma of liver involved . . . . .	2
Serous membranes affected . . . . .	2
Udder glands affected . . . . .	1

Dr. Bryce reports four groups of post-mortems, in which the per cent of the various organs found diseased was as follows:—

Number in each group . . . . .	58	48	138	7,329
Lungs . . . . .	73	70	82	75
Glands, throat, and lungs . . . . .	79	56	61	29
Pleura . . . . .	26	..	7	55
Mesenteric glands . . . . .	10	..	22	48
Intestines . . . . .	5	..	1	2
Liver . . . . .	42	..	14	28
Uterus . . . . .	6	..	1	10
Spleen . . . . .	..	2	2	19
Udder . . . . .	7	25	22	..

There are reported 7,329 post-mortems in which the disease was recognized as follows, in cases and per cent. It will be understood that in nearly all the cases several separate organs were affected.

	Cases.	Per cent.
General tuberculosis . . . . .	459	6.26
Lungs . . . . .	5,178	75.37
Pleura pulmonalis . . . . .	3,812	55.49
Peritoneum and mesentery . . . . .	3,316	48.27
Pleura of chest wall . . . . .	3,209	46.71
Bronchial and mediastinal glands .	2,022	29.43
Liver . . . . .	1,940	28.24
Spleen . . . . .	1,273	18.53
Uterus . . . . .	699	10.17
Inguinal glands . . . . .	364	5.30
Pharyngeal glands . . . . .	299	4.35
Trachea . . . . .	233	3.39
Udder . . . . .	111	1.62
Intestinal . . . . .	89	1.30
Ovaries . . . . .	86	1.25
Lymph glands of liver . . . . .	80	1.16

The lymphatic glands of the thorax and abdomen, the heart, kidneys, stomach, brain, bones, etc., were found diseased in less than one per cent of the cases.

These figures probably do not represent the absolutely accurate proportions of the locations of the disease, for so close autopsies as would be necessary to find the disease in the obscure locations were hardly made in so large a number of cases. From personal observations of over 400 autopsies under the direction of the Massachusetts Cattle Commission, the writer feels confident that the per cent of udder affections above given is far under the average. The table is of value, however, as illustrating the wide bodily area through which

the disease may be distributed, and to counteract the current idea that tuberculosis is only pulmonary consumption.

Among the comparatively infrequent locations of the disease are the brain and spinal cord. Dr. Salmon quotes Semmer as reporting four lesions on the brain in forty observed cases, and remarks: "It is not improbable that, owing to the infrequency of exposing the brain and spinal cord, tuberculosis there may have escaped the attention of pathologists, and it may be that it is not so uncommon as is generally supposed."

This remark is of great importance in considering the statistics now accumulating from the work in progress in Massachusetts and other States. Not infrequently post-mortems on fifty animals are held in a day, by a single observer. His object is not to demonstrate all the manifestations of the disease in his subject, but simply to find it present as a basis of compensation. When this is accomplished, he hastens to another subject; and each goes on record as a manifestation of the disease in the organs where he happened to find it first. If the case were obscure, he might examine several organs; but if quite clear, he would only make a record which as a basis of accurate observation would be quite worthless.

Upon this point Bulletin No. 7 of the Bureau of Animal Industry remarks: "Autopsies upon tuberculous cattle are mainly made when the tuber-

cular virus has become pretty generally disseminated through the lymphatic glands, and even over the serous membranes and through the various vital organs. A determination of the point in the body whence the virus has spread is, in many of these cases, out of the question. On the other hand, when the disease is in the incipient or quiescent stage, it is hidden away in the lymphatic glands ; and unless a thorough search is made through every gland in certain regions of the lymphatic system, the disease may be overlooked. This search is not likely to be made on general principles, for it is exceedingly tedious, and not usually of any definite value in diseases other than tuberculosis.

## CHAPTER V.

### THE GERM AND THE DISEASE.

THE germ of the disease is a vegetable parasite that inhabits animal tissues, and is known as the *Bacillus tuberculosis*. It is rod-shaped, and is variously described as from  $\frac{1}{2500}$  to  $\frac{1}{10000}$  inch in length. It can be artificially propagated and cultivated in blood, meat juices, or in gelatine. Its favorite temperature is from 100 degrees to 102 degrees Fahrenheit, and its vitality is destroyed by a continued temperature of 167 degrees. Its vitality is not affected by drying with moderate heat, by frost, or by the gastric fluids. It dies in a few hours in direct sunlight, and in a few days in ordinary daylight. It has been known to remain vigorous in an ordinary room seventy-five days or more.

As dryness does not affect the bacillus, there is great danger of infection from the mucous or other discharges of those who are diseased. Discharges from the throat and nose, dried and pulverized, may float in the air as dust, and find lodgment, through the breath, in other individuals.

While absolute heat of 167 degrees kills the germ under ordinary exposure, it has been known

to survive a supposed higher temperature. The uncertainty of temperature under ordinary conditions of cooking is such as to render unsafe the use of anything in which the germ has found lodgment, especially by those of delicate health.

Dr. Ernst quotes a series of experiments in his own laboratory by Dr. A. K. Stone, "in which this organism, after an extreme degree of drying, has been shown to retain its vitality and infectious properties for a period of three years and a half at least."

Dr. Law quotes a case where in one store, with a tuberculous clerk, the dust raised in sweeping affected one clerk after another; and a similar scattering of spittle in houses, stores, barns, cars, and streets supplies infected dust to spread the disease indefinitely. With animals, a manger smeared with head discharges from a diseased animal infects the next susceptible animal using it. Drinking troughs and all stable appliances are also channels of infection. The germ survives in water and moist earth, and neither salting nor putrefaction will render meats innocuous.

The disease (tuberculosis) of which the germ above chronicled is the single prime cause, is as old as humanity. It has been long known to prevail, both in human and animal forms. As early as four centuries before the Christian era Hippocrates described it; and so long ago as the Middle Ages the animal type of the disease was considered contagious, and the affected flesh was discarded.

Infection occurs by breathing the germs, by swallowing, or by their entrance through a cut or wound. The main sources of infection are the dust of dried spittle of consumptives, or other tuberculous matter breathed or swallowed, contact with tuberculous matter or people, or the use of the meat or milk of tuberculous animals.

The fact of contagion from tuberculosis by inhalation, inoculation, feeding, and other forms of contact, was demonstrated as early as 1865; but the true cause of the contagion was not determined until the discovery of the bacillus by Dr. Robert Koch, in 1882. He demonstrated the presence of the germ in saliva and other secretions, as well as in the various forms of the disease in the organs of the body; and he also demonstrated its infectious character by inoculations upon various animals through the germs obtained from known seats of the disease. In closing the paper before the Physiological Society of Berlin, in which he announced the result of his investigations, Dr. Koch declared a fact, which later observations by scientists of all countries have confirmed: "We can, with good reason, say that the tubercle bacillus is not simply one cause of tuberculosis, but its sole cause; and that without tubercle bacilli you would have no tuberculosis."

Dr. N. Senn says: "If the bacilli are injected directly into the circulation, or gain entrance into the blood current from some tubercular focus, they

become implanted upon the wall of distant capillary vessels, and the nodule which forms at the seat of implantation consists of cellular elements formed by the tissues of the vessel wall. As soon, however, as the bacilli reach the extra-vascular tissues, they in turn furnish their part of the material for the further growth of the nodule. If the tubercle bacillus becomes implanted upon a mucous surface,—as the bladder, intestines, nose, larynx, uterus, etc.,—if such surface is susceptible to tubercular infection, the epithelial cells take an early and active part in the inflammatory process. . . . All tissues, when infected, take part in the process."

In summing up a discussion of the germ theory of disease, Professor Hills and Dr. Rich say the theory is "that those minute plants grow in the body; that the products of their growth are poisonous, and that a definite disease is due to the effects of the poisons produced by a definite species of germ."

They also quote the artificial propagation and proof of a bacillus, usually called the "four postulates of Koch," as follows:—

1. The germs must be found in the blood, lymph, or diseased tissues of man or animal, suffering or dead from the disease.
2. The germs must be isolated from the blood, lymph, or tissue, and cultivated in suitable media outside the animal body. These pure cultures must be carried on through successive generations of the organism.

3. A pure cultivation thus obtained must, when introduced into the body of a healthy animal, produce the disease in question.

4. In the inoculated animal the same germs must be found again.

Since Professor Koch's announcement, the connection between the germ and the visible manifestations of the disease has been so thoroughly demonstrated that in ordinary practice the detection of the germ by the microscope as proof of the disease is rarely necessary. In several hundred autopsies on diseased cattle witnessed by the compiler of this volume, there were scarcely half a dozen cases in which the visible record of the disease was not clearly apparent.

In a discussion of the infection of tuberculosis, W. H. Chapin, M. D., of Springfield, said the question is settled in the affirmative forever. But he considered the details of infection an important subject of study, and had tabulated and analyzed the deaths reported from the disease in Springfield from 1868 to 1894. He included in the list not only cases classed as tuberculosis, but also those which seemed to him to belong there, including children's brain diseases, etc. He also said that many cases of typhoid fever and pneumonia would be included if autopsies had been made; but all these he had excluded.

Dr. Chapin's list included about 4,800 cases, including those confessedly tuberculous, and all cases

of convulsions, spinal meningitis, cerebral congestion, hydrocephalus, cerebro-spinal meningitis, tubercular meningitis, brain fever, and brain disease in infants. He considered that the diagnosis of tubercular meningitis is altogether too infrequently made. He analyzed the 4,800 cases, and found that in 3,372 cases, or 72.5 per cent, no relative had died in Springfield of tuberculosis in twenty-five years. The proportion of tubercular meningitis to other cases of brain disease was about the same in the family groups as in the other groups.

Dr. Chapin found peculiar relations of brain diseases to other diseases. Thus, of 346 cases of brain disease 43 deaths occurred within a year from consumption in the same family, 24 were within two years, 18 within three years, and so on ; 12, 11, 12, 9, 5, and 5, respectively, within nine years. The further away we get from deaths from consumption, the fewer deaths appear from the allied disease. He called attention to the fact that a case of ordinary consumption occupies about three years, and said that 50 per cent of all deaths from brain disease in children in tuberculous families occur within three years of a death from consumption. He said that in districts where houses are new and the people are well-do-do, there is less consumption ; while among old houses and poor people the disease is rampant. Where other infectious diseases flourish, tuberculosis flourishes. In these old houses the floors and walls are reeking with it.

Harold C. Ernst, M. D., says he does not believe in the hereditary nature of tuberculosis, but thinks that the widespread scattering of the infectious material and its characteristics account for its occurrence in families and in neighborhoods. The bacillus is very retentive of life. He considers that the expectoration from persons affected with pulmonary tuberculosis is the most general source of infection ; and he says that the bacillus may be found in the spittle before the physical signs of the disease appear in a destructive process of the lungs ; therefore the earlier stages are most critical, as well as most infectious.

Dr. George H. Bailey, State Veterinarian of Maine, says in his Report for 1892: "The days of discussion regarding the heredity and contagion of tuberculosis have passed away, and it is no longer possible to doubt the dangers to which tuberculous animals expose their neighbors and their progeny. So long as such animals discharge virus by the respiratory and digestive passages, and by the mammary secretion can infect healthy subjects by its introduction into their digestive apparatus with food or drink, or into their respiratory apparatus with the atmospheric air, they will continue to remain a menace to the public health. Rigorously, the theory can be maintained that a tuberculous animal is a subject dangerous to the property of others, and it is not permitted to any person wittingly to injure any one ; therefore, if the animal that is the source of the injury does not dis-

appear by the good will of the owner, society has the right to exact its destruction."

Dr. Salmon says: "Tuberculosis would not by many be considered contagious in the sense that foot-and-mouth disease is, because of the insidious beginning and slow course of the disease. Yet the bacillus must come from pre-existing disease in either case."

## CHAPTER VI.

### ONE DISEASE IN MAN AND CATTLE.

BESIDE the proof that mankind are infected with the disease by the use of meats and dairy products from diseased animals, and that the disease has been transmitted from men to animals by inoculation, the identity of the disease in the two is shown by numerous well authenticated instances in which it has been taken on by veterinarians and others through cuts or scratches received while making post-mortem examinations of diseased animals.

It is beyond question that the germs, the post-mortem appearances, and in many respects the symptoms of the disease, are the same in man and in animals. Professor Hills and Dr. Rich declare: “Human tuberculosis infects the lower animals, and, what is vastly more important, and the central fact, bovine tuberculosis infects man.” They express the belief that “countless thousands of deaths have occurred due to this source of infection, which have not been thus described, and of which no record has been made.”

Dr. E. O. Shakespeare, formerly United States Cholera Commissioner, says: “With all its terrors,

cholera is not nearly so deadly as tuberculosis ;" and " it has been found that in infants and young children in some large cities the mortality from some form of tuberculosis is far greater than is generally believed, amounting in some localities to one fifth of the deaths in the young. The significant fact in this connection is, that it is most frequently some part of the digestive passages that become first affected."

When it is once recognized that the various diseases are the offspring of the one bacillus,—that of tuberculosis,— the questions of infection and poisoning by the life product of the bacillus become of great importance.

Whatever may be the relative responsibility of cattle and man in the dissemination and the perpetuation of the disease, it is quite certain that there is an intimate relation between the two in this regard. It is plain that wherever cattle are few or absent there is little or no consumption among the people, and that wherever civilization has introduced cattle consumption has soon followed.

In the temperate regions of Europe and the United States, statistics show that 12 per cent of all deaths are from consumption. In New York city the rate is reported at 20 per cent. Among the American Indians, who use diseased meat without cooking, the rate is 50 or 60 per cent.

Recent statistics show that in Fall River the death-rate among children from cholera infantum

is 50 per cent more than it is in Boston; and there is reason for the inference that this excess is due to the fact that the Fall River mothers wean their children very early, and feed them on cows' milk, to allow the mothers to resume their mill work. If the cows are tuberculous, the excess of cholera infantum through the infection of the mesenteric glands of the infants would be the natural explanation of the excessive mortality.

Dr. Abbott, of the Massachusetts State Board of Health, supports this idea. He said in a legislative hearing, in 1892: "The milk supply is one of the most important food supplies that we have. It begins with the life of the children, and a large number of children are dependent upon the milk of cows; and we know very well that the health of such children, as compared with the health of those who are fed from their own mothers, is very much poorer, and their death-rate is greater. Whether this simple question depends on tuberculosis, of course I could not say; but it is certain that tuberculosis may be—I think that it is conceded now that it may be—conveyed in this way. . . . As this is one of the methods that can be controlled to a certain extent, it certainly is an important matter, and one which measures should be taken to control."

Dr. E. F. Brush, of Mount Vernon, N. Y., who has given years of attention to the matter, has frequently published the statement that tuberculosis

does not exist among people who do not employ milch cattle. Drs. Hills and Rich quote this and say: "The inference to be drawn is not that human tuberculosis comes mainly from cattle,—for man gets his infection mostly from his fellow man,—but that possibly the primary source of infection and more or less of its maintenance and extension are due to cattle. Whatever the inference, there is little question that human consumption is relatively less prevalent in countries where there are few or no cattle. . . . In some of the western South American countries cattle are used only for beef; so many cases of consumption have been traced to the use of milk that the entire population with scarcely an exception leave it alone."

Dr. Donohue, in an address elsewhere referred to, says that the broad fact is established that a tuberculous cow may give tuberculous milk, and will do so if her udder be affected; and if in a given case the tuberculous cow does not give infected milk, it is only a question of time when she will do so.

Irving A. Watson, M.D., says: "It has been proven that pulmonary consumption in the human family and tuberculosis in animals are precisely the same disease; and that this disease is a communicable one, as it is largely, if not wholly, a preventable one."

In a paper read in June, 1894, before the National Live Stock Sanitary Convention, Dr. Kellogg, of Michigan, spoke of the identity of tuberculosis in

man and animals as "demonstrated," and said: "Numerous investigations have shown that the products of the dairy are in some sections to a most astonishing extent infected with the microbe, which is responsible for the loss of more human lives than any other, not excluding the organisms which give rise to those dreaded maladies, small-pox and yellow-fever." He also says that "infection of the human race in civilized communities with the bacillus tuberculosis has come to be at the present time exceedingly common. Indeed, it may be said that such infection threatens to become universal."

M. Van Hertsen, Dr. Fleming, and Herr Lydtin, whose report to the Brussels Congress of 1883 has been before alluded to, in summing up the data submitted, say:—

"We arrive at the conclusion that all the evidence points to the fact that tuberculosis of mankind and that of animals is one and the same disease, which, more than any other, chooses its victims from among warm-blooded animals, irrespective of species, provided they live in agglomerations.

"1. Tuberculosis has been observed in all warm-blooded animals submitted to domesticity or deprived of their liberty.

"2. Tuberculosis in animals and mankind presents analogous manifestations, in the living as in the dead creature.

"3. The course and termination of the disease in mankind and animals is the same.

“4. The masses of tubercle, and especially the sputa of the phthisical, produces tuberculosis in animals when these matters are introduced through the respiratory or digestive apparatus, or through a deep wound. Tuberculosis, inoculated from man to animals, may in its turn be transmitted from one animal to another, and always produces tuberculosis.

“5. Tuberculosis of man and of animals is transmitted by heredity.

“6. The disease is contagious in man and animals.

“7. There are clinical observations which prove the transmission of tuberculosis from animals to man, by the consumption of the milk of phthisical animals.

“8. Tuberculosis of animals and man is rare in cold climates, where it does not even appear to be developed. It is most frequent in Southern countries. The tracings of the geographical propagation of the disease in man and animals are nearly parallel.

“9. It is evidently proved that a pathogenic microbe, having the same morphological and biological characters, exists in the tubercle of man and in that of animals. This organism, whether it be developed in man or animals, may induce tuberculosis when, cultivated in a pure state, it is conveyed to the animal possessing the necessary receptivity.”

## CHAPTER VII.

### PREDISPOSING CAUSES, — NOT HEREDITARY.

WHILE it is scientifically established that the disease is propagated only by its germ, and the old idea of the inheritance of the disease is disproved, it should be understood that there are certain conditions of the animal system which may be termed predisposing causes. While none of these causes can generate tuberculosis in the absence of the bacillus, if the bacillus is present the causes contribute to its development. As in the case of all disease, a delicate or debilitated or depleted condition of the system invites it; and it will find lodgment when a stronger or more healthful constitution might repel or overcome it.

Among the predisposing causes usually recognized, heredity has its place. The germ is not inherited, but conditions favorable to its reception and development may be. Observations in Saxony show that with 165 tuberculous cattle in 1,000, there were only two tuberculous calves in 1,000. At Lyons only five diseased calves were found in 400,000, and at Munich there were but two in the same number.

Close or ill ventilated buildings, dark stables, insufficient or unwholesome food, breeding too young or too frequently, inbreeding, over-feeding to secure abnormal milk production, and, in short, any treatment of cattle that tends to debilitate or over-stimulate, may be considered as a predisposing cause.

Observation has demonstrated that the idea of the heredity of the disease must be replaced by the theory that family predisposition invites the disease. Thus Dr. Law quotes a case in which in 1877 he recognized the disease in a herd of thoroughbreds. The worst were slaughtered, and the milder cases (young animals) were pastured by themselves during the summer. They indicated robust health until after they were housed in the fall, when they began to fall away, and after another examination eleven more were destroyed. It was ascertained later that these two killings had removed every representative of a certain family,—not even a grade being left.

Dr. Senn says: "It is more probable that the hereditary or acquired predisposition to tuberculosis, which must now be recognized as an important element in the causation of the disease, must be regarded rather as a diminution of the power of resistance inherent in the tissues to the action of the specific microbic cause than any characteristic anatomical cell defects. From a clinical standpoint, it is important that in the causation of tuberculosis

we must recognize a combination of etiological factors; namely, (1) local or general conditions resulting from hereditary or acquired causes, which diminish the resisting capacity of the tissues to the action of the bacillus of tuberculosis, which must be regarded as the predisposing cause; and, (2) the presence in the tissues of the essential cause of the disease,—the bacillus of tuberculosis. The predisposing cause can under no circumstances result in tuberculosis without action of the essential cause; and the bacillus of tuberculosis is most certain to produce its specific pathogenic effect in tissues debilitated by hereditary or acquired causes."

In discussing this branch of the subject Dr. Senn also quotes Whittier, who compares the causes of syphilis and tuberculosis: "One man is not more predisposed to either disease than another. Syphilis affects one person more than another, because its virus finds a better lodgment upon the mucous membrane. Tuberculosis finds also, fortuitously, a better *nidus* in one case than another. The virus of tuberculosis is lodged, in one case, and not coughed up; just as in syphilis the virus is secreted, and not washed off." And again: "From any deposit of syphilis reabsorption may take place at any time, and reinfection with syphilis; or, better, the reappearance of external signs. So from any caseous nodule, wherein the tuberculous virus is locked up in temporary innocence, absorption may take place under favoring circumstances, and a

new outbreak of tuberculous symptoms appear. . . . While the virus is thus locked up, the disease is latent; when set free, it is manifest."

On the effect of unhealthy surroundings, Dr. Law says imperfect ventilation spreads infection by animals breathing the same air, and by concentrating the germs in a confined space; that diseased cattle improve when turned to pasture, and fall away when returned to the stable; that the disease is absent or very infrequent on Western ranges, and most abundant where cattle are most closely confined; that a moist, changeable climate favors germ development, while dry and rare air and uniform temperature tend to suppress it; that faulty feeding lowers the vitality and the animal's power of resistance; that in-and-in breeding, and early, late, or too frequent breeding have a similar effect; and that anything resulting in ill health must be viewed as a predisposing cause.

Dr. F. R. Brush of Philadelphia calls the cow "the wet-nurse of consumption," and explains the connection between animal and man in the following:—

"Scrofulous females in the human race usually secrete an abundance of milk, because in scrofula there is an unusual tendency to glandular enlargement and activity. As the mammary is the highest type of glandular structure, it is stimulated to increased action. A scrofulous cow is usually the largest milker; and the closest kind of consan-

guinity has been practised by cattle breeders, with the object of producing a scrofulous animal,—not because she is scrofulous, but because the particular form she represents are the largest yielders of milk. We find, too, that consanguineous breeding has been alleged as one of the causes of tuberculosis in the human race, where it can never be conducted with so close and intimate blood relations as in the dairy animals.”

## CHAPTER VIII.

### NATURE AND CERTAINTY OF TUBERCULIN.

THERE are but three tests known to veterinary science that can be relied upon to declare with any degree of certainty the presence of the bacillus of tuberculosis in the animal system. These are the examination of the animal secretions by the microscope; the inoculation of other less valuable animals with these secretions; and the injection of tuberculin. Aside from the last named, these tests are manifestly impracticable for general use. They have long been at the command of scientists, and the disease has steadily increased. It would be impossible even to control it through these agencies.

The injection of tuberculin is, however, a universally available and a practically certain test. It declares the presence of the disease with certainty in its earliest as well as its later stages. Its only failures have been from ignorant or careless use; and these have thus far been so infrequent as to weigh nothing against its real value. As its character and application are better understood as the result of intelligent experience, even these few failures will cease to be reproduced.

The present prominence of tuberculin as a diagnostic agent is a curious illustration of the facts that a failure in one direction is often a success in another, and that no scientific research or discovery is without its value as a contribution to general knowledge, even if its especial aim is not reached. If the latest claim for tuberculin, as recorded at the close of this chapter, proves correct, it will also illustrate the possible success that often lies beyond failure and discouragement.

A few years ago the medical and scientific world was intensely interested in the announcement of the discovery by Dr. Robert Koch, of Berlin, of a lymph which was to be a cure for consumption in the human family. The results of the tests to which it was put by Dr. Koch and others were watched with great interest; and when it was finally determined that the discovery was a failure, there was a general sense of disappointment in the scientific world. It failed because it was found that, while its early promise was encouraging, its final result was usually the rapid acceleration of the disease it was intended to cure.

The operation of tuberculin in the human patient was carefully watched by Professor Gutman, of Dorpat, Russia; and after its use as a curative agent was abandoned, he was induced to test its application as a detector of the disease among animals. His observation led to the fact that, wherever administered to a tuberculous patient,

tuberculin produced a characteristic rise in temperature and the acceleration of the progress of the disease. It was apparent that such a result could not be invited in the human patient; but it was entirely proper to invite it if the presence of so obscure and so dangerous a disease among dairy animals could thereby be demonstrated. He instituted a series of experiments in the administration of tuberculin, followed by a series of post-mortem examinations, through which he learned that his theory was correct; and he was also able to point out the features of fluctuation in temperature following its administration, by which the presence of the disease could be demonstrated, and by which it could be distinguished from other diseases which are attended with a rise in temperature. His discovery of this valuable property in tuberculin was announced in 1892, and its acceptance by the veterinary profession is already general throughout the civilized world.

Tuberculin as used in the detection of disease is a thick fluid, the agent itself being diluted with glycerine, so that there are but three drops in a dose of thirty drops, which is the usual application.

Every infectious disease is transmitted by a germ, which, once introduced into the system under favorable conditions, grows and multiplies. This germ may or may not be harmful of itself; but each throws off as a product of its life a substance which also may or may not be harmful. Just as

carbonic acid gas is thrown off as a product of human life, tuberculin is thrown off or evolved as the life product of the tubercle bacillus. It is a physiological poison; and it, rather than its parent, the bacillus, is the agent which produces the effects of the disease. It cannot enlarge itself, and it cannot produce the disease in a healthy system. It is quickly and steadily eliminated from the system by natural processes; but while it is present the bacilli propagate rapidly, and these in turn throw off new supplies of the destructive agent. Thus tuberculin in tubercular animals has a continuous destructive action, reacting with the germ of which it is the product within the body; while it and its associated bacilli are thrown off from the system through the various secretions; the latter are scattered far and wide to infect other animals and the human race.

The process of artificially producing tuberculin is as follows. A quantity of the bacilli of tuberculosis is selected and separated from all other bacteria. They are then placed in a tube containing the serum or clear part of ox blood, meat juice, or any other favorable material, and the mixture is kept at blood heat for several weeks. During this time there is a rapid increase of the bacilli, and a resultant accumulation of tuberculin in the developing fluid, or culture, as it is called, until the whole mass is saturated.

The contents of the tube are then subjected to a

heat of 250 degrees Fahrenheit for forty-eight hours to kill the bacilli. They die in a temperature of 167 degrees, but the higher temperature is insisted on to make absolutely certain the extermination of every germ. Then the contents of the tube are filtered through porcelain under air pressure, until all the dead remains of the bacilli are strained from the liquid. It is again heated to 250 degrees to make assurance doubly sure that no germs remain, and then the mass is evaporated to dryness.

The result is tuberculin, absolutely free from any germs. It is then dissolved in glycerine with a small proportion of carbolic acid, the dilution making a 10 per cent preparation. It is carefully put up in vials and securely sealed, to prevent the infection by germs that may possibly be in the air; and it is not opened except for the filling of the hypodermic syringe with which it is administered.

Its administration is a simple process in competent hands, and consists only of the injection of the required amount in the cellular tissues just under the skin, usually behind the shoulder of the animal. The operation is no more painful than the prick of a pin, and if the animal operated on is free from tuberculosis there is no apparent result. If the above description of the production of tuberculin is understood, it will be plain to every reader that it cannot possibly introduce the disease in any case.

Professor Hills and Dr. Rich declare that "the detection of tuberculosis in its earlier stages by

external signs is usually impossible. Unless the lesions are in the lungs, even advanced cases are hard to detect. An animal in this condition may be sleek, fat, and frisky, may give large amounts of apparently normal milk, and yet may be infecting other stock as well as those using her milk."

Professor Mackenzie, after describing the physical symptoms of the disease, says: "It will be seen from this brief outline of the clinical features of the disease, that a diagnosis is hardly possible until the disease is far advanced, and that even then diagnosis may not be considered absolutely safe."

He then discusses the methods of detecting the bacilli in milk by the use of the microscope; but he quotes approvingly the conclusion of Professor Ernst, that "the virus may be present in the milk while yet the closest examination fails to reveal the tuberculosis of the udder."

In this connection he cites the interesting conclusion of Scheurlen, "that bacteria which are incapable of independent motion (as is the bacillus of tuberculosis) settle quite rapidly when submitted to centrifugal action; at least, they separate from the milk, but a great percentage are carried up with the cream." This opposes a somewhat prevalent idea that the bacilli may be removed from milk by the use of centrifugal cream separators. If they are to be concentrated in the cream, and later in the butter, it is a separation hardly to be

desired. The experiment may be of interest in the laboratory, but it is useless in the interest of public health.

Dr. Irving A. Watson says: "The great value of tuberculin as a means of determining the existence of tuberculosis in a herd of animals is far beyond that of any other means or methods known. In fact, it comes so near being an infallible test that the errors of diagnosis based upon its use are practically nil. By this means the disease can be detected when in its incipient stages, long before it would be possible for the most skilled veterinary surgeon to discover it by the ordinary physical examination. In fact, it places in the hands of state and national authorities the means through which bovine tuberculosis may be eradicated, and without which it would not have been possible to do more than to hold the disease in check, even if that could be accomplished."

Dr. F. O. Donohue, Secretary of the New York Tuberculosis Commission, in a recent paper read before the American Public Health Association, stated that his board had made the tuberculin test an especial study; and that they were convinced that it was perfectly harmless to healthy animals, and that their board condemned no animal that did not respond to this test.

Bulletin No. 7 from the United States Bureau of Animal Industry, in concluding the recital of recent experience with tuberculin, says: "It

is not necessary to repeat the many favorable opinions expressed by different observers in support of the value which is claimed for tuberculin as an aid in diagnosing doubtful cases of tuberculosis in cattle. The number of instances in which the conditions indicated by the results of the injections do not conform to the conditions found on post-mortem examination is so many times less the number of errors from all other methods used to diagnose tuberculosis, and there are so many cases of tuberculosis which could not possibly be detected by any other method, that even they who are least inclined to favor the use of tuberculin cannot fail to recognize its importance.”

The Connecticut Commissioners on Diseases of Domestic Animals, in their report for 1894, describe their use of tuberculin as satisfactory. They say: “The trial of tuberculin has been ample for you to determine its approximate value as a diagnostic agent, both for the detection of tuberculosis in all stages and the differentiation between it and other conditions. In all those cases tested by your board not an instance of failure has yet appeared. Carefully used, with conscientious attention to every detail, it appears to be beyond doubt the only safe method by which bovine tuberculosis can be detected in its earlier stages. Such errors as have been reported in the use of this lymph have been only such as would naturally be expected as incidental to a comparatively new experiment, especially when in

the hands of those not familiar with its use. It has now passed the experimental stage ; and after being tested on many thousand animals, we are, I think, warranted in agreeing with its most enthusiastic advocates that it is indeed one of the greatest of modern discoveries in the medical world."

The impossibility of determining the presence of tuberculosis by physical examination is thus stated as the result of their experience by the Massachusetts Cattle Commissioners, in their report for 1894 : " Prior to October 4, the existence of the contagious diseases in these animals was determined by the Commission upon a physical examination ; and, as before stated, in the cases of tuberculosis the results were found to be exceedingly unsatisfactory both to the Commission and to the owners of the animals. The symptoms were so unevenly shown that animals which were apparently sound were released, and in some cases afterward found to be affected with the disease ; in others, animals which appeared to have the symptoms of the disease were, after slaughter and upon post-mortem examination, found to be free from tuberculosis, but affected with bronchitis, pneumonia, or other non-contagious disorders ; and in this way throughout the State a large number of mistakes occurred, notwithstanding the fact that the greatest care was taken to prevent them. In fact, we were simply repeating the experiences of all other countries that had tried to do anything toward the removal of tuberculous animals from among

their herds, and we felt that the ultimate result was sure to be extremely unsatisfactory to all parties concerned."

The latest European conclusions on the subject of the use of tuberculin as a diagnostic appear in a report of the proceedings in the veterinary section of the International Congress of Hygiene and Demography, at Budapest, in September, 1894. Professor Bang reported on 340 post-mortems after tuberculin. Excluding questionable cases, there were 207 cases in which there was well marked reaction; and of these 96 per cent proved tuberculous. He concluded that tuberculin was an exceptionally reliable agent in the diagnosis of tuberculosis. He said his experiments showed him that in certain localities 80 per cent of the cattle are tuberculous. Under such circumstances he did not favor killing off all that react, but advised that animals showing no clinical indications of disease — that is, the milder cases — should be preserved. He said these may even be used for breeding, by taking the precaution to remove the calves when born, and bringing them up by hand. As most calves which react to tuberculin show intestinal or retro-pharyngeal affection, Professor Bang thought their disease due to raw milk, and advised boiling it from the second day onward. This advice suggests his opinion as to the infectiousness of milk from tuberculous cows.

Professor Bang reported tests in Seeland, where two years ago he tested 208 cattle on one estate,

and found 80 per cent of the cows, 40 per cent of the steers, and 40 per cent of the calves infected. The sound animals were separated from those infected, and special attendants were provided. The calves and diseased mothers were separated at birth, and the calves fed on boiled milk. A few weeks after birth the calves were tested with tuberculin, but not one reacted. Each year the whole herd was injected twice. The first year, when isolation was incomplete, 10 per cent of the presumably healthy animals reacted; the second year only one out of 107 was affected, and in the spring of 1894 only two out of 122.

It is unfortunate that Dr. J. A. W. Dollar, from whose report of the Congress to the Central Veterinarian Medical Society of London these statistics are taken, does not tell what became of the group of cattle originally isolated, nor of those exposed by the later semiannual tests. He remarks, "Bang's method seems the easiest and cheapest for stamping out tuberculosis;" but just how much "stamping out" was done does not appear. The facts given indicate only that, as actually diseased animals were removed from the herd, there was a great decrease in the spread of the disease.

We cannot question Dr. Bang's skill as a veterinarian nor his care as an observer, but there seems to be good reason to question his conclusions. He advocates in this report the preservation of diseased animals, but insists that they shall be isolated

from other animals, and not allowed to suckle their own calves. He thus admits the extreme danger of infection from diseased animals, either by contact with other stock or through milk to their calves. It will hardly appear, to an American farmer or breeder, that it is a practical matter to keep a cow who must be isolated, and whose milk is not fit even to feed a calf. Certainly the milk could not be fit for human consumption, and to keep such a cow for a calf once a year would be extravagant on ordinary farms. It would be much more sensible to kill the diseased animal at once.

The report says that in 1893 Denmark provided a large sum for experiments with tuberculin, and Professor Bang was intrusted with the work. Up to the assembling of the Congress he had inoculated 8,401 animals on 327 farms. Of these, 3,362 (or 40 per cent) reacted. The greatest number of diseased animals was always found where the traffic was most active, isolated farms being often entirely free.

Dr. Hess, of Berne, said that after using tuberculin the animals often showed loss of appetite, great depression, and diminished yield of milk. Here, again, the report is incomplete, as we are not told whether it was the healthy or the diseased animals that exhibited the unfavorable symptoms. If the latter, the known effect of tuberculin in accelerating the disease, if present, might account for the symptoms. That Dr. Hess was referring to

animals that reacted seems probable from his later remark, that the worst effects of tuberculin are the "production" of acute tuberculosis; and therefore, while he considers tuberculin an excellent diagnostic in most cases, he warned the Congress "against relying on it in either old or widespread tuberculosis, and laid stress on the frequent occurrence of acute miliary tuberculosis."

Professor Nocard referred to experiences in France, Saxony, Berlin, and Copenhagen, which point to the contraction of the disease in adult life. He considered that heredity plays a very insignificant part in its spread. He said long and intimate contact is necessary for infection; and that in Paris, since the custom has obtained of keeping milch cows only one year and then sending them to the butcher, the disease has greatly decreased, while when they were kept five or six years the disease was very widespread. He considered tuberculin the best test for the disease, and, in opposition to Dr. Hess, said he had seldom seen even a falling off in milk after its use. He recommended testing all suspected animals with it, but considered the immediate slaughter of those that react unnecessary, if they do not show symptoms by physical examination. By merely isolating them, their usefulness for work or milking is preserved, or they may be prepared for the shambles. He had seen only two cases of generalized tuberculosis in two thousand cases tested with tuberculin.

Professor Ostertag pointed out the great danger of allowing animals to feed from a common manger,—a method, he said, which especially favored the spread of the disease.

At the conclusion of the discussion, President Dammarin summed up the results as follows: "The essayists are agreed that tuberculin is a most valuable diagnostic agent. The number of failures with it are practically unimportant. The greater number of those present do not share Dr. Hess's views as to the frequent occurrence of acute tuberculosis after inoculation, and therefore consider his warning unnecessary."

Dr. James B. Paige, V. S., who has had charge of the herd at the Hatch Experiment Station of the Massachusetts Agricultural College since 1890, writes of the early attempts to suppress tuberculosis there: "At the time of the examination of the animals by Dr. Law (1890), and for some time after, nothing was known in this country of the use of tuberculin as a diagnostic agent of this disease; and we had confidently expected up to the date of its introduction to be able, by the weeding-out process, by the immediate slaughter of suspicious animals, by careful selection, breeding, and good sanitary surroundings, to eradicate the disease from the herd. That in all probability we should never have been able to accomplish this is shown by a study of the records of the tuberculin tests. These tests at the Station extended from October, 1892,

to June, 1894, and in all 55 animals were killed, of which 14 did not present the characteristic reaction of tuberculosis, but were killed as a precautionary measure and for observation."

Dr. Paige summarizes his conclusions from observations of this herd as follows:—

“ 1. That it is unsafe to purchase animals, to add to a healthy herd, from a herd in which tuberculosis has existed.

“ 2. That poor sanitary surroundings—especially imperfect ventilation and insufficient light—are favorable to the rapid spread of tuberculosis among cattle.

“ 3. That it is much better to dispose of excrement outside of stables than in cellars underneath them.

“ 4. That mangers and other stable fixtures which increase the amount of surface, cracks, and corners that cannot be easily cleaned are objectionable, from the fact that when the germs of tuberculosis become scattered under such conditions, they are not easily destroyed by the use of disinfecting fluids.

“ 5. That infected stables bear close relation to the propagation of the disease.

“ 6. That even by the use of strong disinfecting fluids it is very difficult, if not impossible, to rid an old stable of the germs of tuberculosis.

“ 7. That the diagnosis in most cases of this disease by physical examination is impossible.

“ 8. That in tuberculin we have an exceedingly delicate and reliable test for tuberculosis.

“ 9. That tuberculin indicates the existence of tuberculosis in the lungs and other parts of the body when objective symptoms are absent, and when no germs can be discovered by microscopical examination of mucus from the nostrils.

“ 10. That its use is not followed by any ill effects of a serious or permanent nature.

“ 11. That in some instances the injection of tuberculin produces a marked rise of the internal temperature where no tuberculosis exists.

“ 12. That in some cases, where tubercles are present in the body, its injection is not followed by a well defined reaction.

“ 13. That the reaction following the use of tuberculin bears no relation to the extent or development of the disease.

“ 14. That it is impossible to formulate a rule by which we can say that certain variations of temperature may or may not indicate the presence of tubercles.

“ 15. That in tuberculin we have the only means by which we can eradicate tuberculosis from among our cattle.

“ 16. That our old-style and unsanitary stables, thoroughly infected with the germs of tuberculosis, make the complete eradication and suppression of this disease wellnigh impossible.”

In support of his conclusion 11, Dr. Paige cites three cases in his record of tests. In view of a more

extended observation of the test, it may be said, in explanation of these apparent failures, that in case one the first rise in temperature was fifteen hours after injection, and it did not remain up hardly as long as would be desirable to be conclusive. In case two, the first rise was fifteen hours after injection, and it remained up only at one observation, dropping at the next from 106.2 degrees to below normal. This, in the light of late experience, would entitle the animal to a retest. In case three there was a perfect typical reaction. The disease was not found on autopsy, but the thoroughness of that may fairly be questioned.

In support of conclusion 12, Dr. Paige quotes one case where the reaction which he says was not well defined *was* certainly well defined ; but it was not so strong as is usual. Its maximum was 1.2 degrees, which is quite close to the accepted indications at the Virginia Experiment Station, elsewhere quoted.

It would not be fair to the public nor to the subject to omit, in this connection, a reference to the latest experimental phase of tuberculin. In the foregoing there is presented substantially the known facts in regard to it. What follows is not yet demonstrated, but it comes with so much of weight and possibility as to give it great interest to all who are engaged in the problem of public health as affected by tuberculosis.

As appears elsewhere, Professor Koch abandoned tuberculin as a curative agent, when he found that

in very many cases it proved to be an accelerator of the disease it was intended to control. To him it was a failure, but others seized upon the feature which condemned it as a curative, and utilized it with great success as a diagnostic. It is generally understood among scientific students that Professor Koch's discovery was prematurely given to the world, and its alleged virtue as a curative of consumption was proclaimed before he was prepared to declare his work as complete.

Tuberculin was to him a single substance, whose ordinary effect, in cases of tubercular disease, was to incite fever and hasten the end, but in his experiments, as well as in those of others who have given attention to it, there were individual cases where decidedly curative results were seen, or where it produced immunity from subsequent infection, but they were hardly more than enough to serve as the "exceptions that prove the rule."

Among those who have been at work with tuberculin is Professor Edwin Klebs, who has earned the confidence and gratitude of the whole world by his discovery and application of "anti-toxine," which is so rapidly coming into general and successful use as a specific against diphtheria. Observing the varying and contrary effects of tuberculin in different cases, he was led to consider whether it was really a homogeneous single substance, or a compound whose separate elements might cause the varying effects.

He pursued the subject in his laboratory, and quite recently has given the public the result of his work. He claims to have resolved tuberculin into three separate elements,—toxines, toxalbumens, and a germicide,—and to have so isolated the germicide, a sozalbumen to which he has given the name “anti-phthisin,” that he can produce it as a commercial article.

This new substance, Professor Klebs claims, is the agent which has produced the curative effects occasionally observed from tuberculin, and that these effects are due to the fact that in some way the “anti-phthisin” was enabled in these cases to exert its normal curative influence without the usual complication and control of the other and toxic or poisonous elements in tuberculin. Having isolated the “anti-phthisin,” he was prepared to test his theory by the usual methods of inoculation of the lower animals, and later by its prescription to the human subject.

The results, as reported by the discoverer, and by Dr. Karl Von Ruck, of Asheville, N. C., who has been intrusted with the secret, have been remarkably successful. The latter reports over 20,000 injections without observing a single instance where it acted detrimentally, or produced undesirable symptoms or discomfort to the human patient.

The observation of these two gentlemen leads them to the conclusion that the failure of Professor Koch’s lymph was due to the effects of the poison-

ous elements in tuberculin, while its occasional successes were due to the agent which they now have in complete isolation and control, and which in their hands uniformly gives encouraging results as a curative agent.

It is administered by subcutaneous injection, and none of the unfavorable effects of tuberculin appear, but in all cases where the lesions of tuberculosis have not so far advanced as to cause a breaking down of the tissues and the consequent interruption of the circulation, decidedly curative effects have resulted, and a restoration to normal health has been secured.

The record of these experiments, so far as published, is most interesting and encouraging, and the success of Professor Klebs's earlier discovery — “anti-toxine” — is, in a way, a factor tending to justify a degree of confidence in his later announcement. The reader needs no reminder, however, that the history of medical science is strewn with failures of alleged panaceas as promising as this. Whatever may be its result, its success or failure cannot affect the acceptance of tuberculin as a diagnostic of bovine tuberculosis. That is established, and if the new “anti-phthisin” should come into general use as a curative agent of the disease among cattle, tuberculin would still hold its place as a diagnostic preliminary to the administration of “anti-phthisin.”

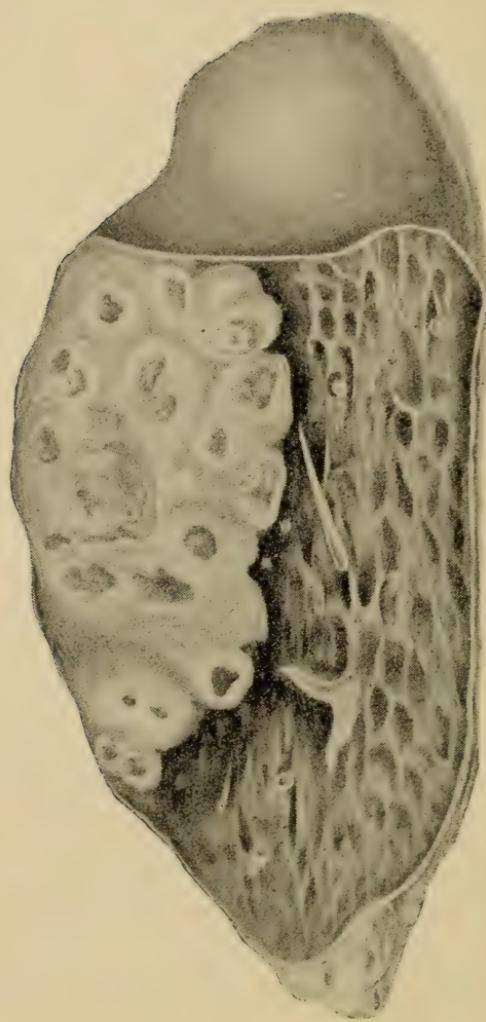
## CHAPTER IX.

### OPERATION AND DELICACY OF THE TEST.

IN cases where tuberculosis is entirely localized on the surface of the body,—as in the case of wounds upon the hands during autopsy, or in the infrequent cases where the disease appears on the surface,—treatment with tuberculin may result in cure ; its application leading to a more active process of cell growth followed by degeneration and death, the dead mass sloughing off, and leaving sound tissues to heal. Usually, however, there are more deeply located colonies of bacilli in connection with the surface manifestations ; and to these tuberculin can only prove an accelerator of the disease, this acceleration being the fact relied upon for its detection under the test.

It should be clearly understood that the system of a tuberculous animal is more or less saturated with tuberculin. The animal becomes accustomed to the presence of poison, just as a man may accustom himself to alcohol, nicotine, or morphia, so that a certain amount is tolerated by the system without immediate manifest effects. But if there is an addition to the amount to which the animal





TUBERCULOSIS OF THE LIVER.

(The upper portion is a large mass of tubercles, cut through to show the extent of the destruction of the normal tissues.)

has been accustomed, the bacilli are excited to unusual activity throughout the system, and the characteristic changes in temperature result.

It is an interesting fact, that in most cases where the disease is but recently established, and has made so little progress that its presence cannot possibly be even suspected by the appearance of the animal, this characteristic change in temperature is most marked. This is accounted for by the fact that the newly established colony of bacilli is most active in its youthful stage; and it is also true that this activity in the early stages renders the animal affected a more prolific source of contagion than when the disease is in a later stage. It is a strong point in favor of the tuberculin test that it thus searches out, excites, and exposes the disease, even in such early stages that only the microscope most carefully used can be relied on to verify the truth of the detective.

The usual practice in the use of tuberculin as a diagnostic of tuberculosis in cattle is first to determine the normal temperature of the animal, which is done by the use of a clinical thermometer, usually inserted in the rectum. Then the tuberculin is injected, the dose being varied from the standard in proportion to the age and size of the animal. This injection is usually at night, as eight or ten hours must elapse before the effect of the injection can be noted.

The next morning the temperature of the animal

is taken again, before food and water are given; and the work is repeated every two hours until the test is completed. After the first morning observation of temperature, food and water are given in only moderate quantities, and the animal is kept in the stall during the test.

There is some variation among animals in their response to the test; but the first indication of rise in temperature is expected in about ten hours after injection; and it is expected to continue eight or ten hours, or until the injected tuberculin begins to be eliminated from the body through the excretions, when it is expected to fall to or below its normal stage.

There are numerous influences constantly or occasionally present in the animal, which may affect the temperature during the test; and these and their complication of the test can be understood and allowed for only by a skilled observer. It is for this reason, coupled with the delicacy of the test in itself, that tuberculin is not a safe agent in general hands. Mistakes have happened, even in the wisest hands, and they would be multiplied indefinitely if the use of tuberculin was made general.

The mere elevation of temperature after injection is but one element in the process of detecting the disease. Other causes may come in to induce a temporary fever, and these must be eliminated. If the animal shows a normal temperature of 101

degrees Fahr., and ten hours afterward it has risen to 104 or above, keeping there for several hours, and then perhaps eighteen hours after injection it falls to or a little below the normal point, the inference of disease is very strong. If, however, the temperature should continue high after the period when the tuberculin should be eliminated from the body,—or if, instead of a single curve of rise and fall, there should occur a rise and fall followed by a second rise and fall during the time the tuberculin remains in the body,—then the inference would be but a doubtful one, and skilful observation of the other conditions would be required. As a rule, however, the best practice in this class of cases is to give the animal a second test after a few days' interval.

The difference between the normal reaction in an animal after injection where the disease is present, and the abnormal phenomena resulting from other causes, may be better understood from the following temperature charts, which were taken in actual practice.

In Chart No. 1, the temperature line shows a typical reaction of tuberculin in a diseased animal, and is such in character, varying only in the degree and continuance of elevation, as is uniformly secured in the tests where all the conditions are normal, and the work is properly performed. Frequently the rise is as high as seven degrees; but this is generally seen only when the disease is in

its early and most active stage. The chart was from an animal far advanced with disease.

Chart No. 2 differs from No. 1 in that, while the rise in temperature — which happened to be coincident with the injection of tuberculin — was

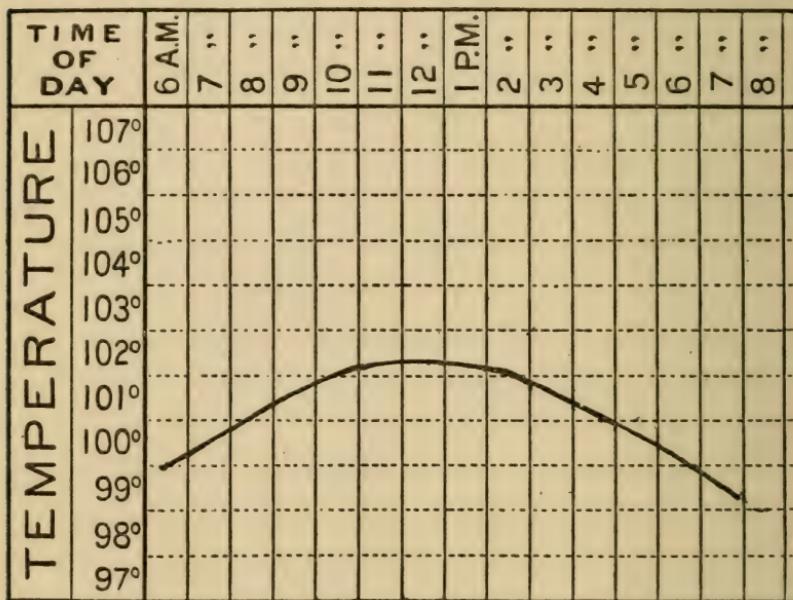


CHART No. 1.

much more marked, and which a hasty observer might readily declare was decisive of disease, it did not recede toward or to the normal point when the tuberculin had been excreted from the body. The animal from which the chart was taken was killed, but the post-mortem disclosed no indications of disease.

Chart No. 3 is somewhat unusual, but it has

occurred, and is noted in several reports. It is known as "the double curve," and in the present state of positive knowledge of chart reading it is considered a puzzle. Some animals furnishing such a chart have been found diseased on post-mortem;

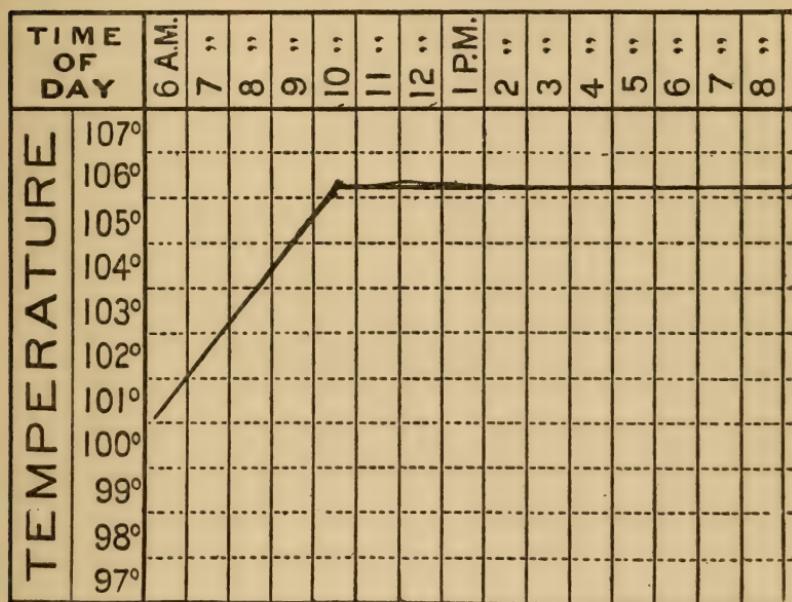


CHART No. 2.

while others, with a chart apparently identical in character, have not disclosed the disease.

At present, in Massachusetts practice, animals exhibiting Charts 2 and 3 are held for retest, their peculiar character indicating some unknown cause of febrile condition other than the sought for disease. They are under careful observation, and it is hoped that increasing experience will soon enable observers fully to comprehend their import.

Dr. E. P. Niles, veterinarian of the Virginia Experiment Station, reports four cases where the reaction was but one or two degrees, and all were proved diseased. He says: "From our own experience we are led to believe that any elevation

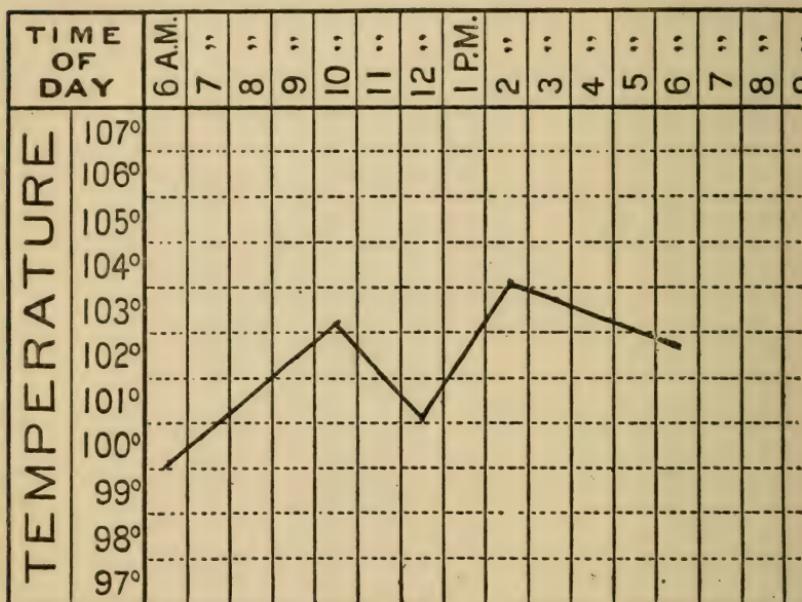


CHART No. 3.

of temperature that continues over two or more readings above the highest normal variation during a period of twelve hours before injection is diagnostic of tuberculosis; and if we expect completely to eradicate the disease from our herds, we must take this as a standard. It would be much more profitable occasionally to destroy a healthy animal than to let one that is diseased escape, even

though we expect to repeat the test in six months' time."

Dr. Niles is also of opinion that the animal system acquires a certain tolerance to the action of tuberculin after the first injection, thereby making a second test unreliable without the intervention of several months.

Drs. Osgood and Lyman, of the Massachusetts Cattle Commission, do not usually accept so slight reactions as are indicated by Dr. Niles, unless quite suspicious physical indications are present. They are also of opinion that tuberculin does not create a tolerance of itself when injected, so that a second injection without the long delay is uncertain. They advise, however, in cows where the period of heat may have complicated the test, that twenty-one days elapse before re-injection, as this avoids contact with the next period of heat. The experience of these two gentlemen, much greater than that of any others in this country, justifies great confidence in their suggestions concerning the details of the test.

It should be stated in this connection, that, where the characteristic reaction of tuberculin has pronounced the disease present, the failure to detect it in an ordinary post-mortem does not settle the question against the accuracy of the tuberculin test. It is the common experience of those of the widest opportunity for observation, that the disease is often found on post-mortem only in a trivial lesion, in some out-of-the-way corner of the body, where it might

readily escape such scrutiny as is possible under the usual conditions in practical work. And even when these slight lesions are not discovered, and reference is had to the microscope without success, still tuberculin is not convicted of error. It has been so often seen to reveal the disease where but the slightest visual traces of it could be discovered, that where no traces are discovered science can only say it was not found. No skilful and wise operator would say more until the most exhaustive examination, visual and microscopic, had furnished a scientific basis for such a declaration ; and such an examination is a practical impossibility.

A bulletin from the Connecticut Commissioners on Diseases of Domestic Animals, 1894, reports twenty-nine tests, in which the normal temperatures were determined by two observations, two hours before and two hours after feeding. The result shows that in twenty-three animals there was a rise of 0.93 of a degree after feeding, the maximum rise being 1.7 degrees, while six of the animals showed a decrease in temperature averaging 0.51 of a degree. The maximum was one degree.

The animals were injected over night, and at six o'clock the next morning twenty showed an average fall in temperature of 0.86 of a degree, the maximum being 2.5 degrees. Seven showed a rise of an average of 1.04 degrees, the maximum being 3.6 degrees. Two showed the same temperature in the morning as the average of the night before. The

eccentricity of these figures, taken by careful observers, confirms what has been said before in regard to the danger of intrusting tuberculin to unskilled hands. Wide general knowledge of veterinary science is needed to balance the varying physical indications, and to read correctly the confusing temperature records.

At a recent examination of a herd in Meriden, Conn., where two animals had been found suspicious by physical examination, nine were exposed by tuberculin; and all, an observer declared, were "as apparently healthy animals as man ever witnessed led out to slaughter." All were found markedly diseased. Their reactions were as follows:—

	Normal.	Highest Reaction.
	°	°
No. 1 . . . . .	101.5	107.2
No. 2 . . . . .	101.3	104.1
No. 3 . . . . .	101.9	106.8
No. 4 . . . . .	102.2	106.0
No. 5 . . . . .	103.0	107.6
No. 6 . . . . .	102.1	106.5
No. 7 . . . . .	102.1	105.0
No. 8 . . . . .	102.0	107.0
No. 9 . . . . .	102.8	107.0

This test has been in use in this country since 1891, the first experiments being by Professor Zuill, of the veterinary department of the University of Pennsylvania. The experiment stations or other agencies of Canada, Maine, Vermont, New York, Massachusetts, New Hampshire, New Jersey,

Pennsylvania, Virginia, Wisconsin, and Minnesota have used it with satisfactory and conclusive results.

The result of the use of tuberculin has been so monotonously successful that as long ago as June, 1892, a scientific journal in Berlin announced: "We shall now stop publishing reports on tuberculin in the Berlin Veterinary Weekly unless they contain some new facts and figures. Since the publication of the reports of the extensive experiments of the Royal Health Office, we may regard the question of the value of tuberculin in the diagnosis of tuberculosis in cattle as settled. The proof which has been presented to our readers is more than sufficient. The results are absolute and gratifying, and show that tuberculin is a reliable agent for determining the presence of tuberculosis in cattle."

Professor Hills and Dr. Rich say of the tuberculin test: "There have been mistakes made by its use by incompetent persons, and it has occasionally failed in careful hands. Experience, however, has brought a greater measure of success; unfavorable reports are now rare, and many who considered tuberculin unreliable are acknowledging that the fault was their own. But notwithstanding its occasional and admitted failures, it has proved infinitely more reliable than any other means of diagnosis now in use."

In most of the literature emanating from various agricultural bureaus and other places where the tuberculin test has been studied, it is insisted that

the normal temperature of an animal cannot be determined by a single taking with sufficient accuracy to serve as a safe basis from which to compute the reaction after injection. This theory is based upon the fact that there are very considerable variations in individual temperature, under normal conditions, at various times during the day; and that these variations, unless determined in each individual case by numerous observations, may complicate and render valueless the record of temperature under the test.

Drs. Osgood and Lyman, of the Massachusetts Cattle Commission, recognizing in their extended experience the increased trouble and expense of these prolonged observations, have worked out a system by which they are able to avoid them. They made a record of some ten thousand temperatures taken on about five hundred animals, recording also their careful observation of attendant physical conditions. These observations have enabled them to secure a basis by which to determine the probable variations in normal temperature which can be applied in individual cases, so that a single temperature taken before injection is generally sufficient. Wherever a notably abnormal temperature is indicated, the test is withheld until the conditions are favorable. This single normal temperature, coupled with the observation and record of temporary physical conditions in each case, has proved so efficient in the thousands of cases that have

passed through their hands without any material error justly chargeable to tuberculin, that they now consider the repeated observations unnecessary to determine the normal temperature.

Professor Mackenzie, in 1892, said of tuberculin: "It may now be considered as past the experimental stage; and if tuberculin never becomes a success as a remedy, it certainly will be used to a very large extent as a diagnostic re-agent in animals." And, after stating the early results of its use,—results which have been almost infinitely reinforced by later observations,—he said: "I think I have made it clear that we have in tuberculin a re-agent which is of immense value in the diagnosis of the disease, especially as it is just in those cases in which other clinical evidence is wanting that it is most certain; for the results have all shown that in animals with only few tubercular lesions, so few that the ordinary health is in no way affected, the reaction is most marked."

He also remarks: "It is quite useless to use the re-agent if we are not going to destroy the animals that give the reaction."

Dr. Bryce, in a recent report on tuberculosis, says of tuberculin, that it is "so delicate and yet so accurate that the most unbelieving among veterinarians are to-day confessing to its marvellous diagnostic value and significance."

Professor Leonard Pearson writes: "In my experience of more than five hundred cases, of which

about one hundred have been slaughtered, I can count but one error in diagnosis,—an old cow, badly diseased, which did not react after a small dose. All of the other results have been most satisfactory. Every cow that gave a reaction and was killed was shown to have tuberculosis."

Nearly all the experience with tuberculin reported thus far has been of its use upon cattle in their normal conditions, in their home stables, and with but a minimum of irritation and excitement. It is well known that milch cattle are nervous, highly organized animals; and it is one of the strongest proofs of the harmlessness of tuberculin that in all these stable tests reported there is no authentic report of injury, or of failure of tuberculin to detect the disease if present, when it was used by intelligent and discreet veterinarians.

The Massachusetts Commission has, however, at the cattle markets at Brighton and Watertown, been brought into contact with far different and more difficult conditions. Most of the cows offered in the market are in full milk; they come in cars, and for a day or two have been milked, fed, and watered irregularly; they have been made nervous by being roughly driven among unaccustomed surroundings, and after they reach the market are encompassed by a crowd of buyers. There is no time for the animals to rest, and to acquire their normal condition of quiet, before they are injected; because the test occupies from twenty to twenty-four

hours, during which time impatient drovers, owners, and buyers are clamoring for the completion of the work, so that their business may be accomplished.

It is under these conditions that this market inspection has been carried on; and while some mistakes have been made because of inexperience, haste, mischievous interference, and the generally unfavorable conditions attending the experiment, the post-mortems have shown but comparatively few failures. The writer has been personally conversant with every step of this work, and is quite aware of the sweeping charges that have been brought against it by interested and prejudiced parties; but he is confident that, while errors and mistakes are admitted, they are chargeable not to the failures of tuberculin, but to the conditions under which the tests were made. As these conditions have become better understood, and some of them have been made subject to control, the proportion of errors has greatly decreased. The only wonder, to one familiar with the delicacy of the test and with the surrounding conditions at these markets, is that errors are not more numerous. The record of the work at these markets, up to the latest date to which the figures could be inserted here, is as follows.

The work began on November 21, 1894, and the record for 14 weeks, to March 1, 1895, shows 4,226 animals tested, and 250 condemned. Of these, 14.8 per cent failed to show evidences of the disease at the post-mortems. Counting all these as failures,

the record shows success in 85.2 per cent of the condemned cases. But it should be remembered that the failure to find the disease with the hasty and imperfect methods of autopsy compelled by the conditions, and the element of mischief, whose proportions are not yet determined, are so important factors in the result that a considerable discount from the above estimate of failures must be allowed.

Another branch of the work of the Massachusetts Cattle Commission, but just begun, is the systematic inspection with tuberculin of all the cattle upon the farms. The counties of Nantucket and Dukes have been completed. A total of 1,837 animals have been tested in these two counties, with but seven condemned, all of which proved diseased on post-mortem. In addition to the seven condemned on the two islands, seven other animals were bought and killed because of physical indications which induced the agents of the board to withhold the brand of soundness. None of these last, however, proved to be tuberculous.

The extremely small percentage of disease in these counties is credited to the fact that the stock is almost entirely home-raised, is kept largely out of doors under favorable sanitary conditions, and is not forced to undue milk production,—conditions which are everywhere recognized as unfavorable to the development of this or any other germ disease.

The third branch of the Massachusetts Commission's work is in responding to the calls of local

inspectors. These officials make semiannual examinations of all cattle in their respective districts, and report all suspicious cases to the Commission. Agents who are trained veterinarians are then sent to test these suspected cases with tuberculin, and the temperature charts are sent to the Commission for decision. The basis of all this work being animals that are suspected on physical examination, it would be unjust to use it as a basis for any estimate of the prevalence of the disease. As showing the accuracy of tuberculin under normal conditions, however, it is of interest.

Up to March 1, 1895, the number of animals thus tested has been 4,437. Of these 1,367 were indicated as diseased, and on post-mortem nearly all disclosed lesions of tuberculosis. When these figures were compiled the returns of the agents were not all in, so that the actual number of failures to find the disease on autopsy could not be given, but such cases have been very infrequent,—doubtless not over a quarter of one per cent. It is worthy of note, as indicating the uncertainty of physical examination, that in these cases only a little over 30 per cent of those reported suspicious proved to be diseased.

Bulletin No. 7 of the Bureau of Animal Industry calls attention to the delicacy of observation required correctly to read the temperature charts, saying: "Before we can determine in what measure the result of tuberculin injections correctly indicated the presence or absence of a tuberculous

affection, we must form a more or less definite idea of what is in truth to be called a reaction. On this point little agreement apparently exists between different observers, which is not an extraordinary fact when we consider the marked normal variations in the temperature of milk cattle, the readiness with which the temperature of many animals is influenced by slight and frequently unrecognizable causes, the dissimilar conditions under which different herds live, the lack of constancy in the quantity of tuberculin injected, and the possible variations in the strength, purity, and state of preservation of the tuberculin used. The elevation in temperature necessary to constitute a reaction has variously been given from 0.9 to 1.8 degrees Fahr. But it is not sufficient to consider merely the number of degrees the temperature after the injection rises above the temperature before the injection. The height reached by the temperature and the duration of the elevation certainly cannot be disregarded. In estimating the reliability of the results from tuberculin injections where the temperature after the injection is low, Eber maintains that a rise of not less than 0.9 degree Fahr. must occur, and be continuous during many hours, before the presence of fever can be conclusively affirmed. A low temperature after the injection is specified as 103.1 degrees Fahr. This is a rule which we believe it is necessary to observe."

The experience in Massachusetts, which is far more extended than elsewhere up to the present

time, justifies a demand for a more marked rise in temperature than is above indicated; and while the moderate rise is looked upon as suspicious, it would hardly be accepted as a conclusive indication, unless physical symptoms appeared in corroboration. A rise of 1.5 or of 2 degrees Fahr. with physical indications might be accepted; but it would also be expected that the post-mortem would reveal a very advanced and generalized case of disease. A considerably higher rise should be looked for in a case where the disease was incipient, or but recently established.

The report of the Bureau of Animal Industry gives a table of results of the injection of sixty-three animals, of which seventeen gave reactions of 2.5 degrees Fahr. or less. On post-mortem it appeared that six of the seventeen were not diseased. The details of these cases were as follows:—

Highest Reaction.	Length of Reaction.	Result.
1 degree . . . . .	1 hour . . . . .	Not diseased.
2.3 " . . . . .	11 " . . . . .	Diseased.
2.4 " . . . . .	13 " . . . . .	"
2.2 " . . . . .	17 " . . . . .	"
1.6 " . . . . .	7 " . . . . .	Not diseased.
1.2 " . . . . .	7 " . . . . .	" "
0.5 " . . . . .	6 " . . . . .	Diseased.
1.8 " . . . . .	17 " . . . . .	"
2.2 " . . . . .	13 " . . . . .	"
0.5 " . . . . .	8 " . . . . .	"
1.6 " . . . . .	16 " . . . . .	"
2.4 " . . . . .	16 " . . . . .	Not diseased.

1.2 degrees	7 hours	Not diseased.
2.5 "	13 "	Diseased.
2.0 "	11 "	"
0.2 "	3 "	Not diseased.
2.0 "	13 "	Diseased.

When, in addition to the above general considerations, it is taken into account that only a moderate supply of food, water, or exercise may result in a rise in temperature in a cow of from 1 to 1.5 degrees Fahr.; that her condition as to fatness has its influence on temperature variations; and that temporary physical conditions (heat, calving period, etc.) may furnish other complications,—it will be readily seen that the work of correctly interpreting the temperature chart is not an indifferent affair. To include and properly balance all these elements, and to draw therefrom an accurate deduction, demands far more knowledge and astuteness than is possessed by the ordinary farmer. Such work should always be confided to a veterinary expert.

In a recent discussion upon this subject Dr. Leonard Pearson said: "I have examined about five hundred cases, and have killed a few over one hundred animals that reacted; and all those animals that have reacted showed tuberculosis on post-mortem examination. I should say, however, that some of them showed it but very slightly; and in some of them it required a very careful examination to discover the tuberculosis. In one of them in particular

(I do not know that there was more than one) I could find no tuberculosis at all, nothing but an inflammation of the mesenteric glands of certain small portions of the intestines, and a little pleurisy. The mesenteric glands were examined (by microscope), and the tests showed that even in this case the animal was tuberculous. In fact, in the sections of the mesenteric gland tuberculosis bacilli were exceedingly numerous. There were great numbers of them, and for that reason some of them were kept for class demonstration as showing a large number of tubercles in a small area. I have heard of a few cases that reacted, and under post-mortem examination tubercles were not found. . . . I have read of a number of other cases that did not react when tested with tuberculin ; and I have heard of a few cases in the western part of New York State in which the animals did not react, but were killed, and afterward found to have tuberculosis. But in all these animals the disease was quite advanced, and I think that is the reason. You know tuberculin is the product of the growth of tuberculosis bacilli ; and it is fair to suppose that in general tuberculosis the system is so thoroughly saturated with it that the small amount of tuberculin injected makes no difference. But a few of these cases were so well marked that they could have been recognized even before injecting tuberculin ; so the tuberculin test in these cases was unnecessary. My own experience has been most gratifying, and I am

using a good deal of it now, and expect to continue it."

Dr. Anderson Crowforth, V. S., related the following experience before the Ontario Veterinary Medical Association at Toronto, December, 1894: "While examining a herd of domestic cows by the ordinary means,—that is, without the aid of the tuberculin test,—I discovered one cow that I suspected, and ordered her to be treated with tuberculin. Through a mistake of the herdsman that was not discovered till after the examination by the tuberculin test, he submitted the wrong animal. She was a cow six years old, apparently in good health, and did not show the slightest trace of tuberculosis by ordinary means; and when tested by Koch's lymph she proved to be diseased, her temperature rising to 108 degrees Fahr. fifteen hours after the injection. The post-mortem showed tubercles in most of the lymphatic glands, lungs, kidneys, adipose tissue, and, lastly, the liver,—this last containing a tubercle, which I have preserved in my office, weighing several pounds. This led to a test of the rest of the herd with tuberculin, and I discovered that 50 per cent were affected. In another herd of 37, reaction after tuberculin occurred in 31, while 6 gave no reaction. When killed, the 6 proved sound, and the 31, without exception, tuberculous."

## CHAPTER X.

### OBJECTIONS TO THE TEST ANSWERED.

ASIDE from the eccentricities of temperature heretofore alluded to,—which may result from other diseases, from the animal being in heat or near to calving, from lack of discretion in the allowance of food or water during the test, or from active exertion or unusual excitement, all of which are within the observation of the expert, and should be considered in his conclusions,—there are in the public mind certain other features which are urged against tuberculin as a reliable test of the presence of disease. Most of these are fallacious, but they deserve explanation in this connection.

It is correctly alleged that the expected variation in temperature fails to appear in some cases where the presence of the disease is demonstrated by autopsy. These cases are rare, and are usually of the extreme type where the system is so thoroughly permeated by tuberculin that the small amount added by the injection has no appreciable effect. In such cases the disease is usually apparent on a physical examination. They do not, however, appear with sufficient frequency to justify their quotation against

the general efficacy of the test. So rare are they, indeed, that some veterinarians of extended experience express doubt of their genuineness.

It is alleged that the test causes reactions or rise in temperature in slight cases where the animals might live and be profitable for years. This is also true, and it would be a valid objection if the prime object were to perpetuate the disease and the offering for sale of the diseased products. But if the desire is to detect and eradicate the disease, the fact that this agent exposes it in its otherwise secret and most dangerous stages is one of its most creditable features.

That this reaction is thus caused by tuberculin is shown by an early German experiment when thirty-one animals reacted out of a herd of thirty-seven. All were killed, and the six that did not react were found healthy, while the entire thirty-one were found diseased. Only one of these showed general disease, and was sold as cheap meat, while all the others were accepted as fit for food. This illustration suggests that the German standard of fitness for food is not so high as in this country ; and it should be said also that the incident was early in the history of tuberculin, and that the peril of using any part of an infected carcass is much better understood now than heretofore.

Dr. Law, in discussing this phase of the subject, says : "While a cow with one or two tubercles only in the lymphatic glands may not be liable to transmit

the disease to others, yet whenever an extension takes place, the germs being carried by the blood, and therefore throughout the whole system, there must always be danger of their escape from the natural surfaces to infect other animals. And, let it be borne in mind, this diffusion through the blood takes place before its occurrence is revealed by the formation of tubercles in new situations. So long, therefore, as a single victim of even slight tuberculosis is left in a herd, it can only be looked upon as an invitation to a renewed extension of the disease. It also may become at any moment a source of infection for man through the use of meat or milk. It is only in degree that the contagion of tuberculosis differs as to its sanitary aspect from that of any one of the more contagious diseases, and in all alike. So soon as we attach more importance to the preservation of an infected animal that may possibly recover than we do to the radical extinction of the disease, we undermine and destroy the effectiveness of our sanitary work. . . . Is the remorseless scourge of tuberculosis to be perpetuated, not only in herds, but in our homes as well, to save for a few months or years some tuberculous cows? No country has ever dealt successfully with any of these animal plagues on the basis of preserving the mild cases for recovery. Always and everywhere it has been by the radical and thorough extinction of the disease germ wherever found that success has been achieved. While

this cannot be done for man, it must be done for our flocks and herds if we would ever cut off this prolific animal source of tuberculosis from the human race. Even as regards the herds themselves, the stock owner who would consult his own future interests would at any cost exclude from his farms and fields every possible source of future tuberculosis."

It is admitted by nearly all authorities that the use of the tuberculin test tends to aggravate tuberculosis wherever it is present; but this is no objection to its use, if the purpose is to destroy the disease wherever found. If the early German system, which preserved the animals that were but slightly affected, is adopted, then, of course tuberculin should not be used. It is useful only where radical measures are determined on. Dr. Law's summary of the situation is: "The tuberculin test aggravates existing tuberculosis, and is therefore unwarrantable for use on man, or on cattle that are to be kept alive. It is, however, the only known means of detecting many occult cases of tuberculosis, and is therefore indispensable in any systematic effort to stamp out the disease by the purchase and slaughter of every tuberculous animal."

It is sometimes urged that the use of tuberculin may produce the disease in healthy animals; but, as has been shown in the description of the process of manufacture, this result is practically impossible.

Dr. George H. Bailey, Maine State Veterinary Surgeon, writes, under date of November 15, 1894:

“ Experiments thus far conducted seem to establish the fact that tuberculin injected into well cattle causes no reaction, and no injurious effects; while if diseased in the slightest degree, the exposure is certain, and the autopsies almost invariably confirm the diagnosis. There may be some rare exceptions to as broad a statement as the above; but such variations can all be explained by the physical condition of the animal at the time the test is made, especially if submitted to incompetent persons. Or the animal may be so thoroughly diseased that its system is already saturated with the natural tuberculin, so that the slight addition has no effect. Usually such cases may be detected without recourse to tuberculin, or in spite of its lack of reaction.”

Dr. M. Stalker writes: “ The theory that tuberculin prepared as it is can produce tuberculosis, is too absurd for discussion. Such a claim does not possess the dignity of respectable nonsense.”

Elaborate experiments by the United States Bureau of Animal Industry, to discover whether the injection of tuberculin produces results other than a rise in temperature, of so characteristic a nature as to furnish a basis for conclusions indicative of the condition of the animal, have failed to disclose any such results.

Professor Pearson, after describing experiments showing a rapid advance in the disease subsequent to injection with a large dose of tuberculin, quite parallel with the experience of Professor Koch

with the human subject, declares: "The normal dose, instead of doing harm, may produce good effects; and I have several cows under observation that gave decided reactions when first tested, clearly indicating the presence of tubercles; but after receiving three or four injections of tuberculin, the reactions ceased, the general condition of the animals improved, and at present it is impossible to elicit evidence of tuberculosis, either by physical examination or the tuberculin test."

This is the first and only testimony found, after an exhaustive examination of the literature of the subject, indicating a substantial curative result. The observations indicate this; but they may perhaps be quoted in support of a claim that repeated injections of tuberculin produce an immunity to its further effects,—a claim, however, which quite careful and extended experiments by Drs. Osgood and Lyman tend to disprove.

An interesting detail in the successful use of tuberculin is suggested in a paper by F. L. Russell, V. S., Professor of Veterinary Science in the Maine State Agricultural College, in a paper published in the "Journal of Comparative Medicine and Veterinary Archives," Philadelphia, December, 1894. He presents a somewhat extensive comparison of the effects of large and small doses of tuberculin, from which he concludes that small doses are entirely effective. He reports complete success, confirmed by autopsies, with doses of from 0.05 to 0.015 cubic

centimeters. The usually accepted average dose has been 3 cubic centimeters.

It would not be just to the public, nor to those who are working or who propose to work with tuberculin, if allusion were not here made to the widely quoted unfavorable results of its use by the Rhode Island State Board of Agriculture. It is freely stated that tuberculin has failed in that State in 25 per cent of the cases where it has been tried.

It appears, however, from the reports of the Society's officials, that this statement rests upon a single experiment, where thirty-two animals were pronounced diseased by a tuberculin test, and eight of them failed to disclose the disease at the autopsy. The only comment necessary in this connection is, that, in view of the mass of testimony in support of tuberculin as an accurate test under normal and controllable conditions, it is quite as safe to refer the failure to a lack of thoroughness in the autopsy, or to lack of experience in the operators, as to accept the reported facts as conclusive against the value of tuberculin. It has been carelessly stated that Professor Law was responsible for the work and for the report; but he emphatically denies the story, and, as elsewhere appears, expresses the strongest confidence in tuberculin as a diagnostic of bovine tuberculosis, and advises its general use by properly educated agents.

## CHAPTER XI.

### THE TRANSMISSION OF THE DISEASE.

THE present degree of knowledge of the infectious character of the *Bacillus tuberculosis* has been reached through a long series of carefully conducted experiments by leading scientists in all parts of the world. Two processes have been used,—the feeding to animals of food known to be infected, and the injection into their systems of tuberculous matter obtained from other living animals or from human beings.

There is one feature incident to the experiment of the feeding of tuberculous matter to animals which tends to prevent uniform results. In 322 European experiments of this character, 13 per cent resulted in the transmission of the disease. Dr. Law accounts for the small per cent of favorable results in these tests by citing the varying susceptibility to infection in the several animals subjected to the test, and the varying degree of infection in the material used for feeding.

The condition of the digestive organs of an animal at the time such an experiment is tried is also an important factor. The bacillus thrives

in an alkaline or neutral medium, and is weakened or destroyed by acids. If, therefore, infected material enters a stomach where the gastric juices are abundant and sharp, and where the digestive processes are active, the bacilli are less likely to survive and set up fresh infection than in a stomach where the juices are weak and the digestive processes are partially suspended. In the latter case their chances of passing on to the mesenteric glands are much more favorable. So, also, if there happens to be any abrasion of the mucous membrane in the mouth or throat, the germ may find lodgment and enter into the system by absorption; or if it happens to pass from the mouth to the lungs, it will find there a favorable spot for colonization.

It is also proved by experiments that the bacillus varies in energy as it is derived from one animal or another. Thus the germ from an ox is almost certain to infect a guinea-pig by inoculation, while its vigor is so reduced by passing its progeny through several generations of birds that the pig cannot afterward be infected by it. But if the germ from the last bird is inoculated in the guinea-pig it soon regains its normal vigor. The same variation in potency appears in germs taken from different cattle, all apparently equally diseased.

There is also a difference in potency in the material fed, the diseased glands and the contents of tubercles being much more certain to infect than

the blood or the muscular tissue of an infected animal; and the peril from milk is found to vary greatly, but not always in proportion to the localization of the disease in the udder.

Dr. E. P. Niles, veterinarian of the Virginia Agricultural Experiment Station, in a recent bulletin, says: "Although the lesions may be local, the germ may be in all parts of the body, since it is circulated by the blood and lymph. It may be stated, in this connection, that the germ is necessarily circulated in the system for some time before general tuberculosis takes place. The mere fact, then, that the visible lesions are local is no indication that the flesh and milk of such animals are free from the germ. That the milk of tuberculous animals is exceedingly dangerous is demonstrated by the fact that a large majority of all the deaths of bottle-fed infants in the large cities are due to some form of tuberculosis."

Included in Dr. Ernst's report of his experiments under direction of the Massachusetts Society for Promoting Agriculture, which there has been so frequent occasion to quote in this volume, is an article by Dr. Henry Jackson, of Boston, on tuberculosis among the Hebrews. From statistics gathered under his observation in Boston for three years, he finds one case of tuberculosis in 30.3 individuals among Gentiles, and only one case in 83 among Jews. He also shows by statistics from European sources that Jews show a much greater

longevity than other races. At first sight a reason for these differences might be inferred, and perhaps justly so far as the European figures are concerned, in the exclusion from the Jewish dietary of tuberculous meats by the Mosaic code; but Dr. Jackson seems satisfied that there is not a sufficient observance of the code in Boston to account for his statistics.

Dr. Jackson discusses in this connection the evidence that tuberculous meat is infectious, and quotes Nocard, an eminent French authority, that meat of tuberculous animals can under certain circumstances be dangerous; but it is very exceptional, and where it occurs it is only to a slight extent. He also quotes another French authority, M. Butel, who says: "Tuberculous meat and milk are the prominent, and perhaps the chief, cause of consumption in man. . . . The danger is formidable, both on account of the large number of tuberculous animals which enter into consumption, and the frightful number of persons that a single animal can infect, and because each person in turn becomes an agent in the spread of the disease."

At the first Congress for the study of tuberculosis at Paris in 1888, where the above opinions were expressed, after a prolonged discussion the following proposition was adopted with but three dissenting votes: "It is proposed to follow out by all means, including indemnity to owners, the general application of the principle of seizing

and destroying all meat of tuberculous animals, no matter what the severity of the lesions in the animals affected."

It seems a fair conclusion, from the expressions of the latest and best authorities, that there is, as compared with milk, but little danger of infection with the disease by the use of the muscular tissues of beef. The reason is that discoveries of the *Bacillus tuberculosis* in muscular tissue of beef are comparatively rare. Its favorite haunt, in the bovine race, is the glandular system; and the only practical danger of infection from lean beef is the possible presence of the bacilli in the numerous small glands that are located among the muscles, some of which are not removed before cooking. It should be remembered, however, that the conditions are different in regard to pork. Here the bacilli are found to generally pervade the flesh, so that the danger of infection is much greater from tuberculous pork than from tuberculous beef.

The blood is understood not to be a favorable home for the germ; but it seems certain, from experiments, that it may survive the unfavorable location long enough to allow lodgment in glands or tissues where its development is certain. All the facts show that the general diffusion of the disease so frequently found to exist must be due to its transmission throughout the system by the circulation of the blood.

That the blood can and does infect is shown by a recent Massachusetts experiment, where a litter of pigs, whose mother was proved to be free from the disease, were kept under a slaughter-house where they had no food but corn meal and the blood-drippings from tuberculous cattle; and all were found to be badly diseased in a few weeks.

Professor Hills and Dr. Rich state that hundreds of experiments have proved that tuberculosis can be passed from a diseased to a healthy animal. A German author reports 650 successful experiments in the transmission of the disease to the lower animals.

At a hearing before the committee on public health of the Massachusetts Legislature, Dr. H. C. Ernst stated that he "had here something like two thousand references to articles written in all languages, and in different parts of the world, bearing upon and proving the infectious nature of tuberculosis, including only the literature extending over about the past seven years."

At the same hearing Dr. Ernst cited a case of localized tuberculosis of the tongue: "A gentleman perfectly well on Thanksgiving day, so far as he knew, by eating something infected with tuberculosis, became infected with tuberculosis of the tongue. . . . He had a nodule half as large again as an English walnut, which was pure tuberculosis, as was shown under the microscope in a piece taken off with the use of cocaine."

In a report of the State Live Stock Sanitary Board of Maryland it is stated: "In the opinion of this board the suppression of tuberculosis is more important than that of contagious pleuro-pneumonia; for while the latter disease affects animals only, the former destroys human life."

It is a curious suggestion that comes from Desmartis, of Bourdeaux, who asserts that he has succeeded in the inoculation of plants with tubercular matter.

Professor Hills and Dr. Rich suggest three general sources of infection. They are: (1) The dust of the dried sputa of consumptives, or other tuberculous matter, either inhaled or swallowed. (2) Contact with the tuberculous material of those suffering from the disease, thus becoming infected either by inhalation, ingestion, or inoculation. For example, in kissing a tuberculous person there might be danger of either ingestion or of inoculation with tuberculous sputa. (3) The meat and milk of tuberculous animals.

In discussing the first two of these sources they say: "The sputa of consumptives containing tubercle bacilli is freely strewn around our streets and buildings. Since the virulence of the germ is not lessened by drying, dust is necessarily a common and omnipresent source of infection. The dust from our streets, stores, dwellings, and places of assembly, particularly where tuberculous people live and congregate, is infectious. The dried sputa

from handkerchiefs, the beds and bedrooms of consumptives, and the mangers of tuberculous cattle, are particularly rich with these germs. This is the main source of infection to human beings, one to which every one is exposed."

In answer to the question, Why, if this infectious principle is all about us, does not every one die of tuberculosis? the same writers say that many do so die,—the death-rate from consumption, which is but one form of the disease, being one in seven, while from all its forms it is one in four.

It needs to be remembered, in considering this phase of the subject, that while all Nature is prolific with disease germs, so too all animal life has in its normal state a wonderful capacity to resist disease. In the human race, air and sunshine, proper food, abstinence from all excesses, regular employment, an easy mind and a clear conscience — in fact, all the elements of life that are usually counted as essentials to normal health — are so partly because they are all naturally antagonistic to disease. The statement is generally true, that in the normal constitution and under normal circumstances these beneficent influences may be relied on to counteract and vitiate the aggressions of disease.

Aside from this general and generally apparent protection, scientists declare that there are natural forces in the body which are antagonistic to germ life, and which are the real causes of immunity.

One theory is that the white blood corpuscles attack and destroy the germs; and another is that the blood serum and tissue juices have a similar function. Other scientists dispute these two ideas, and claim that a certain standard of vitality, based of course on the natural conditions above referred to, is sufficient to ward off the attacks of germ disease. That a normal gastric juice is fatal to many disease germs has been abundantly proved. The general principle will undoubtedly stand that a good condition of health is a barrier against the introduction of germ diseases.

The British Medical Journal reports the following, which shows the tenacity of life of the bacillus under ordinary conditions: "A family of nine occupied a house occupied ten years previously by two tuberculous patients. A short time after, although the whole family had been in splendid health, three among them showed symptoms of tuberculosis. They used the same bedroom as the former tenants. Dr. Ducor had pieces of wall-paper examined, and dust from the ceiling and walls was also examined. In both cases the tubercle bacillus was found. The former occupants had been uncleanly in their habits; the sputa had dried on the walls, and the bacillus retained its vitality."

Dr. Flick, at a recent meeting held to discuss this subject, showed by a map of the city of Philadelphia, which located every house in the fifth ward in which tuberculosis had occurred in twenty-

five years, that the disease chiefly prevailed in a series of infected houses which constituted less than one third of all the houses in the ward, but furnished more than one half the deaths. It was also observed that a large percentage of all the cases of mesenteric tuberculosis in children occurred in these houses.

Dr. Kellogg declares that the sputum of tuberculous cattle and the apartments occupied by such cattle are as dangerous a source of infection as those occupied by human beings, and even more so. He also says: "It is evident that safety from this source of danger to human life can be found only in a thorough inspection, not only of all cows and cattle furnishing food for human consumption, but of all domestic animals which are subject to this disease. The astonishing thing is that there should be so little interest in relation to this question. Tuberculosis is a disease much more rapidly fatal in its effects, much more actively contagious, than the much dreaded leprosy of India and the South Sea Islands, and is almost equally fatal when it has obtained a foothold in the human system."

In considering the ways in which tubercle bacilli cause infection, Dr. Salmon places them in the order of their frequency as follows: (1) by inhalation into the lungs; (2) ingestion into the digestive tract in the milk of tuberculous cows; (3) during coition, when the sexual organs are tuberculous; and (4) from the tuberculous mother to

the foetus of the infant. He quotes German statistics showing infection of the lungs  $14\frac{1}{2}$  times as frequently as of the digestive organs; but these can be hardly accepted in view of the writer's observation of several hundred post-mortems in Massachusetts, in which the disease was manifest in a far greater proportion in the digestive tract. It is noticeable, however, that Dr. Salmon places infection by milk as second in the scale of importance. He also says in this connection: "The source of infection is always some previous case of the disease, for the latter can never arise spontaneously. Hence, in those stables in which there is frequent change of cattle, the introduction of tuberculosis by cattle coming from other infected stables is the most frequent source of infection. Since the bacilli when dried can be carried by the air, it is not necessary that healthy animals should come in direct contact with cases of disease to become infected." On a later page he says: "The disease of the stomach, intestines, and mesenteric glands is very probably the result of food infection. Tubercl bacilli may have been scattered upon the feed by diseased animals. But the most common source of infection is the milk of tuberculous cows. Calves may become infected in this way. The disease may remain latent until the animal becomes older."

In a general discussion of infectious diseases, Dr. Salmon, in 1892, wrote: "The growing facilities for intercourse between one section of the country

and another, and between different countries, cause a wide distribution of the infectious diseases once restricted to a definite locality. Not only the animals themselves, but the cars, vessels, or other conveyances in which they are carried, may become agents for the dissemination of disease. The growing tendency to specialization in agriculture, which leads to the maintenance of large herds of cattle, sheep, and swine, makes infectious diseases both more common and more dangerous. Fresh animals are being continually introduced, which may be the carriers of disease from other herds; and when this is once introduced into a large herd the losses become very high, because it is difficult, if not impossible, to check a disease after it has once obtained a foothold."

Henry Mitchell, M. D., Secretary of the New Jersey State Board of Health, in a recent circular on the communicability and prevention of this disease, emphasizes the former point as admitted by all who are informed on the subject. Of the conditions which aid in causing the spread of the disease he says: "Dwellings, factories, and shops which are located upon damp or undrained sites, or which are so constructed or surrounded or managed that pure air and sunlight do not enter in abundance, or which are supplied with impure water or with imperfect drainage, or which are overcrowded or filthy, will diminish the strength and vigor of the inmates, and assist in rendering them unable to

repel this disease. Persons whose energy is impaired by indulgence in indigestible or unwholesome foods, and those who are insufficiently fed, or who choose foods which do not contain all of the necessary elements of nutrition, and those who yield to habits of intemperance in alcoholic drinks, or to any dissipation, become liable to contract tuberculosis."

The New York State Commission on tuberculosis in cattle declare: "The investigations of this Commission have shown that tuberculosis is under certain conditions congenital; but its general diffusion is due to contagion. But a very small proportion of tuberculosis is disseminated by hereditary transmission. All the facts in the possession of this Commission, as a result of investigation, show that tuberculosis spreads with certainty when diseased and healthy animals are housed together. The contagiousness of the disease is established beyond a doubt, for in most cases it can be traced from herd to herd in localities where dairymen deal with each other in the purchase of cattle from infected herds. The lesions found on post-mortem examination are variable, from small deposits of caseated tubercles to generally disseminated lesions in different viscera. In many cases the udders have been found to be the seat of extensive disease. Some cases of advanced disease were found in the udder from which pus was seen to exude from the teats."

In summing up a discussion of the disease as it

affects the lungs, Dr. Theobald Smith, in Bulletin No. 7 of the Bureau of Animal Industry, after referring to the liability of repeated infections of the same animal says: "The more frequent the infections, the more rapid the disease, and the speedier the danger of the one case transmitting infection to other animals. The fewer the tubercle bacilli in the air, the more reduced the danger. It is highly probable that cattle may, under certain conditions, inhale a few tubercle bacilli without permanent injury. They may become absorbed into the lymph glands, and the disease focus remain small and finally heal. The writer has seen the large caudal gland of the posterior mediastinum extensively cicatrized by old completely healed tuberculous foci. Such changes will of course not be found excepting where the tubercle bacilli were originally deposited. When the disease has once extended beyond the confines of the primary focus, it has acquired sufficient momentum to continue its destructive action uninterruptedly. The importance of reducing the amount of infection in a herd by all possible means, and keeping it permanently reduced, is one necessary condition requisite for the successful eradication of tuberculosis. Even if tuberculin does not reach every mild case, the peculiar nature of the affection, in virtue of which a slight amount of infection may be overcome, bridges over the gap which may have been left by tuberculin."

## CHAPTER XII.

### THE DANGER FROM INFECTED MILK.

A CHIEF danger to the human race from this disease in cattle arises from the fact that the disease is frequently found in the udder ; that milk is generally used without cooking ; and that it is, besides, the chief food of young children and invalids, who from their delicate constitutions are especially liable to take on the disease.

It is true that experiments have often failed in attempting to inoculate the disease from the milk of animals whose udders were not affected ; but, on the other hand, the successful experiments under similar conditions have been so frequent as to justify the warning that the milk of all suspected cows should be discarded. One German expert produced the disease in rabbits fourteen times in twenty-nine experiments with milk from diseased cows whose udders appeared to be free from the disease.

Another German operator inoculated from sixty-three diseased cows whose udders were sound, and secured results in nine cases. A microscopic examination of the udders in the nine cases showed that

only three had traces of the disease, leaving six that were plainly infectious, although the best scientific resources failed to discover the germs in the udder. An American experiment reported by the Bureau of Animal Industry found three cases of infectious milk in six cows whose udders were apparently sound,—one in five being infected from one cow, eight in ten from another, and six from six in the third.

Dr. Law has secured the following authentic cases of infection of human beings by the use of tuberculous milk. A lad five years old, with a clean ancestry, died from acute tuberculosis of the mesenteric glands and the lungs. The family cow was found to be badly diseased. Four infants in a children's hospital in Berne, Switzerland, with clean ancestry, died of the disease as the result of infected milk. The physicians were certain in these cases. A North Hadley case is reported, where a boy a year and a half old spent a week at an uncle's, and used the milk of a cow afterward found diseased. In three months he died of tuberculosis of the abdomen.

In the Medical News of March 26, 1892, Dr. E. O. Shakespeare attributes one fifth of all deaths of infants and young children feeding on milk to tuberculosis, which usually begins in the digestive organs.

Professor Hills and Dr. Rich cite numerous cases which strongly support the theory that milk is

responsible for very many cases of tuberculosis, especially in its intestinal forms, among children.

A Vermont herd of cows revealed seventy-eight out of ninety-one animals diseased by the tuberculin test; and many of the swine fed on the skim milk from this dairy were found as tuberculous as were the cows. On another Vermont farm where the disease was located, over sixty cows, over one hundred hogs, all the chickens, the dogs, and even the family cat, were exterminated on account of the disease, and were proved diseased by autopsy.

Dr. Abbott, of the Massachusetts State Board of Health, expresses this opinion: "The question of disease as propagated through milk is a far greater and a far more important one than the question of adulteration; and it is one which, I think, the State has the same right to control, and to supervise and inspect, as it has in the simple case of the standard of milk."

As early as 1879 Professor Walley expressed the view that "as to the use of milk from animals in which tubercle is suspected to exist, no two opinions can be held; its deleterious effect, even when exposed to a tolerable degree of heat, has been abundantly proved. . . . It would be far better to give compensation, and have even a suspected animal destroyed, than allow her to remain in a herd with the probability of spreading the disease to her neighbors and poisoning the consumers of the milk." It should be noted that at

this comparatively early date in the modern consideration of the question Dr. Walley was so radical as to advise and declare against the safety of milk from even a "suspected" animal.

Professor Mackenzie wrote in 1892: "It has been unfortunately maintained by some writers that there is comparatively little danger of tuberculosis in man resulting from the use of milk from tuberculous cows; but it seems to me that this is an idea which should be combated at every point by sanitarians. One must, of course, grant that appearances show that the great majority of cases of phthisis are due to infection through the respiratory organs; and as long as phthisical patients ignorantly spread the disease in all directions by allowing their sputum to fall in any locality where it may be converted into dust, such must be the case. But this very carelessness masks the real danger from tubercular cattle, and renders it less apparent. The primary tubercular lesions in the adult are undoubtedly commonest in the respiratory organs; but in infants we find the disease often as a miliary tuberculosis, or tuberculosis of the meninges, or of the joints,— all conditions which may be taken to point to an infection through the intestinal tract; and it is just this class, namely, infants, which are most exposed to the danger of infection from milk."

Bollinger showed that a pure culture of tubercle bacilli gives positive results in inoculation experiments in a dilution of 1 to 400,000; thus

showing that milk may be infectious when the bacilli are so scanty as to be undiscoverable with the microscope without an extremely exhaustive examination.

Professor W. H. Welch, of Johns Hopkins University, in an address before the American Medical Association in 1889, quotes Bollinger's statistics, that with cows affected with extensive tuberculosis the milk was infectious in 80 per cent; in cows moderately infected milk was infectious in 66 per cent; and with only slight infection the milk was infectious in 33 per cent. Dr. Welch added: "There is reason to believe that many of the so-called scrofulous affections of children are due to infections from milk from tuberculous cows."

At the Paris Congress in 1888, Professor Bang, of Copenhagen, reported on twenty-seven cows whose udders were diseased, in which the milk of every animal proved tuberculous.

Professor Mackenzie reports, as a result of his own experiments, that where no udder disease appeared on post-mortem, 40 per cent of the milk was infected.

After an exhaustive summary of his reading and observation Professor Bryce concludes: "That while the great number of deaths from tuberculosis in children, as from consumption of the bowels, points to the probability of frequent cases of infection through milk and other food by way of the alimentary tract, yet the still larger number

of cases of lung tuberculosis in children, the relatively small number of calves and young cattle infected with tuberculosis, and the comparatively few instances of tuberculous cattle in which the intestines, mesentery, or other abdominal organs are found on examination to be exclusively tubercular, point very strongly to the conclusion that infection by way of the intestines is relatively seldom in cattle; and that when it does take place in children, it most probably is dependent on the previously unhealthy and congested state of the mucous membrane of the walls of the stomach and of the intestines."

As a typical and not an extravagant type of the possible sequence of diseases, all referable to infection from tuberculous milk in infancy, the following may be considered. A female infant is infected and has an attack of cholera infantum; she is saved by medical skill and good nursing. A little later in life she is subject to convulsions. If cerebro-spinal meningitis supervenes, death will probably end the sequence. But if not, she will be "ailing and delicate" on attaining the age of puberty; after her first child-birth she will show tendency to pulmonary consumption, and, if she survives this, will drop away at the "change of life." Such a sequence has attended the life of many a woman; and only the recent investigation of tuberculosis has made possible an intelligent diagnosis of the various ailments, and their reference to a single infantile cause.

Dr. Theobald Smith, in Bulletin No. 7 of the Bureau of Animal Industry, discusses the dissemination of the disease within the body from the primary seat of infection. He says: "After the lodgment of tubercle bacilli in the primary focus, where their multiplication stimulates the formation of neoplasms or tubercles peculiar to this malady, the disease may after a time become stationary, and the tuberculous products finally undergo calcification. In most cases, however, the disease, after being purely local for a time, and not disturbing the normal functions of the animal to any recognizable degree, spreads from the original focus more or less rapidly, and invades a greater number of organs and structures the longer the life of the infected animal continues. The courses which the virus takes in moving from the primary focus, or foci, to establish new centres are subject to much puzzling variation, and have been the subject of much investigation and speculation. . . . In general, the tubercle bacilli may be disseminated either by the lymph or the blood channels, or by both combined. To these may be added the dissemination by contiguity, which is probably responsible for most forms of tuberculosis of the serous membranes (pearly disease)."

While the world is waiting for governmental action that shall greatly reduce the sources of infection of tuberculosis, the question of whether meat and milk that are or may be infected can be

so treated as to make their use safe to the public is of interest. In a later chapter of this volume Dr. Law's observations on the peril from tuberculin are fully stated. Against this peril there seems to be no shield. But against the infection there is a shield within the reach of every one, but quite liable to be so neglected or so carelessly used as to demand especial emphasis on its importance wherever this subject is discussed.

It has been before stated that a temperature of 167 degrees Fahrenheit is sufficient to destroy the vitalized germs of the disease. It is, therefore, only necessary to cook meats and to scald milk to this temperature to render them comparatively safe.

While beef muscle is not usually affected, numerous small glands embedded in it are frequently so. Therefore, thorough cooking is essential. The flesh of swine is more generally affected, and is therefore more dangerous. Rare roasts, steaks, and cutlets should be avoided, as experiment has shown that, although they may have been subjected to a temperature considerably higher than that above indicated, there is no certainty that their interior portions may not contain living germs. Experiments have resulted in successful inoculations, even after meat has been generously roasted. With milk, the use of a sterilizer or a double kettle is entirely practicable and safe, the only precaution necessary being to continue the heat for from

fifteen to thirty minutes. Care is necessary, in preparing the milk for infants, not to raise the temperature much above 167 degrees, as this would so nearly boil it as to cook its albuminous particles, rendering them indigestible, and harmful as infant food.

But Dr. Ernst is very emphatic on the method of sterilization. He says: "If I sterilized the milk myself, I should be satisfied; but it is not a method that can be applied generally with success. It is not a safe method at all, particularly for the supply of milk to the poor, unless something is done here similar to what is done in one or two of the cities abroad, where the milk is sterilized for the poor at the rate of eight, ten, or twenty thousand flasks a day. But that, of course, is something that we cannot attempt."

Of the result of cooking meats, Dr. Ernst also says: "It destroys the germs, certainly, on the outside; but it does not destroy them on the inside. Every experiment that has been made goes to show that a piece of meat is precisely the same as a roll of cloth. The outside, receiving a high temperature, is necessarily affected by it; but the desired result is not produced on the inside for hours and hours. No roast of meat would be disinfected on the inside by two or three hours' cooking."

Bulletin No. 7 of the Bureau of Animal Industry records a series of carefully conducted experiments to discover the relation existing between the condi-

tion of a tuberculous animal and the degree of milk infection. Some information was also sought concerning the probable extent to which tubercle bacilli occur in a general city milk supply. In the latter class of experiments, the microscope failed to disclose the presence of the bacilli. In experiments by the injection of guinea-pigs, forty trials were made with nineteen different samples of milk. Only one trial disclosed infection on autopsy of the pigs.

In injection experiments with milk from twelve cows, known to be tuberculous, upon thirty-two pigs, only one transmission of the disease was accomplished. In another similar test, where repeated injections were made in the same pig, a similar negative result appeared. The conclusion of the observer, Dr. E. C. Schroeder, is that "a careful inspection of all dairy herds which has for its object the detection and removal of all advanced cases of tuberculosis, and especially of cows with diseased udders, would probably exclude the sale of most infected milk." He also says: "These experimental observations further show that now and then the presumably mixed milk of dairies may contain enough tubercle bacilli to prove fatal to guinea-pigs."

While the foregoing is quoted as a substantial support to the position of those who deny the general peril from the use of tuberculous milk, it does not contribute anything in support of the opponents of the theory of the infectiousness and general danger of the disease. In any candid view of the

question, the results of the as carefully conducted and more extended experiments of Drs. Ernst and Peters, elsewhere given, should be duly weighed.

Dr. A. W. Clement, of Baltimore, Md., says: "It is the general opinion and belief that the majority of cases of human tuberculosis are acquired from the dried particles of sputa in the air; that a very small percentage probably arises from the ingestion of infected meat. Of course it is quite possible that such infection may take place even in adults, as the contact of the tubercle [bacilli?] with any part of the body may produce infection. In children, however, it is quite different. I think the majority of cases in children are in the intestinal canal; and in those cases, of course, it is quite probable that most of the infection is due to the ingestion of food, of milk especially."

Dr. W. E. B. Miller, of Camden, N. J., gives a case which he considers conclusive. He says: "It was the case of a mother having raised a family of four or five children; and there were three or four older ones who were perfectly healthy, as were the father and mother, and no trace of consumption existed among their ancestors as far back as they could go, and no tuberculosis whatever in the family. The mother had ceased to furnish a sufficient milk supply from which to support the child, and they purchased a Jersey cow, . . . especially because they wanted to secure the milk from a single cow for the support of the child. The child lived

and grew to be about two years old, when it developed tuberculosis and died; and in the mean time a second child was born; it also developed tuberculosis; and last summer a third child was born, which now has tuberculosis;— and they have all three been raised from this cow. In this connection I might say I was called to see that cow, and found one of the worst cases of tuberculosis that I have ever met and made a physical examination of in my life. . . . There is no doubt in my mind that all three of these children received the infection from the milk of that animal.”

## CHAPTER XIII.

### CONCLUSIVE TESTIMONY AS TO MILK INFECTION.

DOCTORS Ernst and Peters conducted, in 1890, and later, under the auspices of the Massachusetts Society for Promoting Agriculture, an exhaustive series of experiments by inoculation and by feeding, and made exhaustive inquiries of physicians and veterinarians, to determine the danger of infection through milk from tuberculous cows. Their preliminary report shows the following results, which have but just been made public in detail: "From 114 samples of milk from cows showing clinically no udder infection, 31.5 per cent tuberculous by the microscope; 74 guinea-pigs inoculated with the same milk, 13 per cent tuberculous on post-mortem; 12 pigs fed with the same, 50 per cent tuberculosis; 23 calves fed with the same, 23 per cent tuberculous."

At the close of a report to the Massachusetts Legislature of 1894, they conclude emphatically: "(1) That the milk from cows affected with tuberculosis in any part of the body may contain the infection of tuberculosis. (2) That the virus is present whether there is disease of the udder or

not. (3) That there is no ground for the assertion that there must be a lesion of udder before the milk can contain the infection of tuberculosis. (4) That, on the contrary, the bacilli of tuberculosis are present and active in a very large proportion of cases in the milk of cows affected with tuberculosis, but with no discoverable lesion of the udder."

In response to their inquiries of physicians and veterinarians in all parts of this country, they received numerous answers. The following are from those who had observed or suspected the infection of the human family from tuberculous milk.

From Dr. J. A. Gordon, of Quincy, Mass.: "A child about ten months old, bottle-fed, developed tuberculosis and died. The cow from which the milk was obtained died of tuberculosis a few weeks afterward."

From George H. Bailey, D. V. S., State Veterinary of Maine: "I feel perfectly warranted in saying 'Yes.' I have a case now under observation, where, about a year ago, I condemned a tuberculous cow that proved upon post-mortem to be an advanced case of pulmonary tuberculosis. The milk from this cow was the sole supply of the family, a man and wife; and although there is no history in the family of the woman that can possibly be traced to phthisis, she is in an advanced stage of consumption, as I have every reason to believe from the direct use of the milk of the cow that I condemned. I have another case that closely

approximates the above, but where the history involves the grandparents of the subject."

From Dr. Cornelius Kollock, of Cheraw, S. C.: He wrote of a case where a strong, vigorous child, without a trace of disease in its ancestry, lost its mother at birth, and was suckled by a woman well advanced in pulmonary consumption, in opposition to his remonstrance. The child began to pine at twenty months, was ailing ever after, had hemorrhage at ten years, and died of tuberculosis at fourteen years of age. He says: "I pronounce this an undoubted case of tuberculosis being transmitted through the milk of the woman who nursed the child."

From Dr. M. Stalker, veterinary surgeon of the Iowa State Board of Health: "A few days since I made a post-mortem examination on a cow, the milk of which had been used to nourish an infant. The child died. A searching physical examination of the cow failed to detect the slightest trace of disease; but the post-mortem examination revealed in the clearest possible manner extensive tuberculous deposits."

From Dr. E. T. Williams, of Roxbury, Mass.: "I think I have seen many such,—for example, tubercular disease from milk, mostly in hand-fed babies of perfectly healthy parentage, developing tabes mesenterica, phthisis, and tubercular meningitis; yet I cannot prove it scientifically in a single case. . . . I know that diseased milk breeds tuber-

culosis; but when you ask for details of cases, I am at a loss to give them."

From Dr. R. C. Ward, of Northfield, Mass.: "I have no doubt but tuberculosis in man may come from the consumption of milk from diseased cows."

From Dr. J. T. Whittaker, of Cincinnati, Ohio: "I have had cases — one or two children — of basilar meningitis secondary to intestinal affections and independent of bronchial catarrh, in new houses, parents and attendants unaffected, brought up on the bottle, which I could interpret in no other way, especially as the milk used was from one cow only."

From Dr. P. Paquin, of Columbia, Mo., State Veterinarian: "I have seen three cases of tuberculosis in human beings that seemed to have originated in cow's milk. I have positively induced tuberculosis in animals in five or six cases, by feeding or inoculating milk from cows having tuberculosis in the udder."

From Dr. J. A. Kite, of Nantucket, Mass., who, in answer to Dr. Ernst's question, says: "Yes, but not with scientific accuracy. There were three cases which came under my care from another. All died. No other cause tenable."

From Dr. Arthur H. Nichols, Boston, Mass.: "While believing for many years that our milk supply might be a prominent factor in the dissemination of tuberculosis, I have never found an opportunity for demonstrating such a relationship."

From Dr. O. H. O'Brien, of Rockport, Mass.: "Have seen several, two in particular, in which I strongly believed the cause might be found in the milk of tuberculous cows."

From Dr. Henry F. Leonard, of Boston, Mass.: He writes of a case where a tuberculous cow furnished milk that was used by two adult men, and both died of consumption. "Others saw the cow, and would not take her milk; of these none were ill."

From Dr. Beverly Robinson, of New York City: "I have remarked that children have lost flesh and strength at times, without assignable cause, and with a very clear hereditary history. In such instances, when the parents were closely questioned, I have found occasionally that the children were fed almost exclusively on milk. Now, when the source of the milk supply was inquired into, it was discovered that it was from a locality where I had reason to suspect that there was little or no intelligent supervision of the cattle, and where from the poverty of the people and their bad hygienic surroundings I premised that there might be tuberculous cattle in the herds."

From Dr. Andrew F. Shea, of Lawrence, Mass.: "I could not trace any case of tuberculosis to milk supply; but I have seen cases of tuberculosis in cows in the surrounding country which I feel sure would give rise to tuberculosis in a fit subject drinking such milk."

From Dr. Herbert F. Williams, of Brooklyn, N. Y.: "My difficulty has been with the general statements of patients. In fact, after discovering that none of them have been large milk-drinkers, I conclude it would prove nothing if they were; for one drop of tubercularized milk would do the infection, if the subjective conditions are right. . . . I believe that milk is a convenient vehicle, and the most probable one, for human infection. Investigations into the sudden sicknesses of healthy infants, pointing to gastro-enteric irritation, with subjective cerebral symptoms, would seem to me to be the field most likely to lead to positive results."

From Dr. Francis P. Kinnicutt, of New York City: "While firmly convinced that many cases of tuberculosis in children which I see have their origin in infected milk, such a genesis is exceedingly difficult to demonstrate in a great city, with its milk supply drawn from so many sources."

From Dr. Charles E. Inches, of Boston, Mass.: "From several cases I had become suspicious that tuberculosis originated in the child from nursing, and therefore have for a long time insisted that, where the mother was suffering from tuberculous disease, the infant should be 'reared by hand.'"

The last case refers to human milk, but a wise discretion would view the milk of a tuberculous cow with equal suspicion.

From Dr. N. Bridge, of Chicago, who in answer to Dr. Ernst's inquiry as to observation of infection

from milk replied negatively, but added the following significant sentence: "The fact is, those who can, kill the bacilli, however acquired ; those who cannot, are killed by them."

From Dr. Israel T. Dana, of Portland, Me., who, while replying negatively to Dr. Ernst's inquiry for known cases of infection from milk, wrote : "I have had cases of infants brought up on cow's milk, where neither heredity nor environment would lead to the expectation of tuberculosis, in which tuberculous symptoms have rapidly developed, with fatal terminations. The symptoms have oftener been abdominal than pulmonary. . . . In some of the cases the most natural explanation of the phenomena present has seemed to me to be in the line of infectious tubercle-producing cow's milk."

From W. J. Coates, M. D., V. S., who, in reply to Dr. Ernst's inquiries, indicated a very important point in connection with tracing a source of infection : He wrote: "In regard to the human subject, it is difficult to trace, as there is too great a difference between cause and effect ; by the time the physician could recognize the disease, the milk source would be lost sight of. A man might be ailing for many years, and his disease not appreciated by his physician, until some day he takes what is commonly termed a 'cold,' and develops acute symptoms of phthisis, which will be given credit to atmospheric influences, and not to a source of meat or milk supply which may have been years before."

From Dr. F. Forchheimer, of Cincinnati, Ohio, who, while saying he could not establish "positive connection" of the disease with the milk supply, added the following most suggestive observations: "According to my notion, tuberculosis is by far the most common of children's affections; again, most common in a localized form. The place where it is most frequently found in them is somewhere in the alimentary tract, or organs connected with it. Milk is the most common article of diet in children; milk contains tuberculous material to an extent which, according to my idea, is not properly estimated; so that I have the conviction that tuberculosis is frequently caused by milk. As to a record of cases of this connection, or scientific proof of the same, I should hesitate a very long time before I would put down any individual case as in evidence. Cases are not uncommon, in practice, in which a tuberculous mother nurses an infant, which dies, let us say, of a meningitis tuberculosa. Yet in such a case, in which I am convinced that the mother has transmitted tuberculosis to her child, how can I present evidence sufficiently conclusive to prove that infection has not come from another and extraneous source? I have seen children who, according to the statement made to me, have had no other food but milk, with the following set of lesions: tuberculosis of the glands about the neck, of intestine, mesenteric glands, lungs, and meninges. I am justified, I think, in the conclusion that

the tuberculosis was produced by something introduced into the alimentary canal. I am convinced that it was by means of milk; yet I am not justified in this individual case in stating that this was the cause of my knowledge. In other words, I cannot put down such a case as one capable of exact demonstration."

Dr. Ernst, in his final summary, just issued, based upon all his investigations, says: "(1) While the transmission of tuberculosis by milk is probably not the most important means by which the disease is propagated, it is something to be guarded against most carefully. (2) The possibility of milk from tuberculous udders containing the infectious element is undeniable. (3) With the evidence here presented, it is equally undeniable that milk from diseased cows, with no appreciable lesion of the udder, may and not infrequently does, contain the bacillus of the disease. (4) Therefore all such milk should be condemned for food."

Dr. Ernst summarizes all the replies from medical men to his letter as follows:—

Positive, mother to child . . . . .	8
" cows' milk to child . . . . .	11
Suspicious cases . . . . .	16
Negative, disbelief . . . . .	9
" simply . . . . .	893
Out of practice . . . . .	15
No attention . . . . .	61
<b>Total of replies . . . . .</b>	<b>1013</b>

As showing the percentage of medical men whose attention has been attracted to cases such as the circular made inquiry of, he excludes the replies of those out of practice, or who have paid no attention to the matter. This would leave 937 observers; and counting the positive and the suspicious cases together, he finds that 3.7 per cent of observers have had their suspicions aroused,—“a result that is as unexpected as it is surprising in its size, if one takes into consideration the difficulties surrounding the question, and the newness of the subject.” Besides this, and aside from those reckoned in the above per cent, there were thirty who expressed their entire belief in the actual occurrence of such a method of transmission of the disease.

The replies from veterinarians were still more conclusive. Dr. Ernst classifies all the answers received from these as follows:—

Positive . . . . .	14
Suspicious . . . . .	9
Negative . . . . .	31
Total replies . . . . .	54

Thus it appears that of fifty-four veterinarians fourteen, or nearly 26 per cent. have seen positive cases; and twenty-three, or over 42.59 per cent, have seen cases where they felt justified in suspecting such an origin of the disease as the investigation was seeking.

Dr. Ernst remarks of the last quoted percentage:

“ It is startling in its size, until one remembers the greater facilities that veterinarians have for observing such cases and their origin.” He also remarks: “ Combining the statistics obtained from the two sources, it appears that there were 991 answers received to the circular letter that should be counted; and that among these there were fifty-eight gentlemen who have seen, or suspected, the existence of such cases as were inquired about,— giving a percentage of over 5.84, which seems to be somewhat remarkable, for the reasons already given.”

It should be considered, in estimating the weight to be given the foregoing testimony, that the present knowledge of the details of the action of tuberculosis is of but recent origin; that many experienced and useful medical men do much of their work by routine methods, and their attention is not usually attracted to the relations suggested by Dr. Ernst’s inquiries; and that, as Dr. Forchheimer suggests, scientific demonstration of the facts is of peculiar difficulty. In view of these considerations, the positive assertions of only a small number of observers are most important. Such observations are, though comparatively few, far more impressive and convincing than any number of confessions of indifference or of failure to observe.

## CHAPTER XIV.

### ANOTHER PERIL FROM THE DISEASE.

THE infection of mankind by the tubercle bacillus has been carefully studied and demonstrated, but Dr. Law is the first to point out another danger from the disease.

In explaining the production and the use of tuberculin it was stated that it is a physiological poison, the life product of the bacillus. Dr. Law discusses at length the effect of this poison upon the system, and shows that it pervades the entire muscular tissue of a tuberculous animal, and may be taken into the human system whenever the meat of such an animal is used for food.

While there may be degrees of peril, or in mild cases degrees of safety, in the use of the cooked meat of a tuberculous animal, the cooking temperature possibly being enough to destroy the germ, Dr. Law points out the fact that the poisonous character of tuberculin is unchanged by heat, and that "the professional mind in concentrating its attention on tubercular infection has practically entirely overlooked the no less real, and in many cases no less dangerous, fact of tuberculin poisoning."



OMENTUM, COVERED WITH TUBERCLES.

(The miliary or grape phase of the disease.)



Tuberculin, when taken into the human system with the meat which is charged with it through disease, produces fever and the impairment of the functions of assimilation and secretion. The same results follow as in the case of the production of tuberculin through the progress of the disease in human subjects,—death in these cases resulting not from the ravages of the bacillus so much as from the poisoning by tuberculin, which is thrown off as a result of its life.

While the system of a tuberculous patient may for a long time resist and withstand the poisonous effects of the amount of tuberculin thrown off by its own bacilli, more prompt and alarming results follow the absorption of an added quantity of tuberculin in the meat of infected animals: the bacilli are abnormally excited, their multiplication and their activity are increased, and the crisis of the disease is hastened. And it should be remembered that, as it is in the early stages of the disease that the bacilli are most active, so it is in this stage that the meat of diseased animals is most fully charged with tuberculin, while it is at the same stage that the same poison is most effective in the human subject.

Dr. Law expresses this idea in the following vigorous language:—

“It is this extension of the tuberculosis under the influence of the toxic (poisonous) products of the bacillus which raises the most important ques-

tion in connection with the consumption by man of the flesh and dairy products of tuberculous animals; and yet this question has been overlooked by sanitarians in the most unaccountable way. It has seemed enough for them that the living tubercle bacillus did not exist in the juices of the muscles nor in the meat. It seems never to have occurred to them that all the soluble poisonous products of this bacillus were constantly circulating in the blood which passes through the muscles, and that they equally traverse the blood-vessels of the mammary glands, and escape into the milk. No pathologist can for a moment doubt this general diffusion of these products in the tuberculous subject. Accepting then as undeniable the presence of the soluble chemical poisons in blood, flesh, and milk, it follows that those who eat this flesh or milk are continually taking in small doses of tuberculin; and in that case, if they are already the victims of tuberculosis, in however slight or indolent a form, this continuous accession of the poison will rouse the morbid process into greater activity and secure a dangerous extension.

“ If we now consider the frightful prevalence of tuberculosis in the human race,— that here in New York every eighth person dies of tuberculosis, that in cities like Vienna 85 per cent of the people suffer from it, and that in our own cities 30 to 50 per cent contract it at some period of life,— we see what a fearful risk is being run by the utilization of the meat

and milk of animals so affected, even if it could be shown that such meat and milk were in themselves free from the living bacillus. Such reckless consumption of the products of tuberculous animals can only be looked on as a direct means of sealing the fate of that large proportion of the community which are already slightly affected with tuberculosis."

Against this peril sterilization of milk and the thorough cooking of meats are no defence, for the poisonous character of tuberculin is unchanged by these processes.

Experiments have shown that, after the inoculation of guinea-pigs with the bacillus, the administration of tuberculin greatly hastened the onset of general tuberculosis. Dr. Law points out that, if this is the result with these animals,—which, although very susceptible to tuberculosis, are not easily poisoned by tuberculin,—the peril is far greater to man; and he presents a computation showing this peril to be twenty thousand times greater, weight for weight. He concludes: "We may freely allow that the transmission of the bacillus from man to man is far more common than from beast to man; but though the implanted seed may have been in many cases derived from a fellow man, its subsequent destructive progress may be due far more to the constant accessions of the soluble poisonous products conveyed in the meat and milk of tuberculous animals. Without these constant doses of soluble

poisons of tubercle, the implanted germ would in many cases have proved comparatively harmless. Although it could be proved in regard to many cases that the cow had not contributed the seed of the disease, she is left little less responsible for the destructive progress and fatal result. The germ, which might have remained comparatively dormant and harmless in the absence of the poisoned meat and milk, is by these stimulated to a more deadly energy."

Dr. Kellogg adopts Dr. Law's view, and says: "In the blood and lymph of every animal suffering from tuberculosis there must be circulating a variable amount of extremely toxic substance called tuberculin. The milk as well as the juices of the flesh of such an animal must always contain a certain proportion of this poison. It is thus apparent that whoever makes use of the flesh or milk of such an animal is thereby introducing into his system more or less of this extremely active and dangerous poison."

He also says: "Since the fluid portion of the milk is made up from the plasma of the animal's blood, it is evident that it must contain at least as large a proportion of this extremely soluble and poisonous product as is found in the animal's blood,— perhaps even a larger quantity, the readiness with which toxic substances of various sorts are excreted by the mammary gland being too common an observation to require more than mention.

... If present in the animal when alive, it will certainly be present in its flesh and milk; and those who make use of these infectious substances as food must run an enormous risk of injury."

While suggesting that this view of Dr. Law may not be fully borne out by later investigations, Dr. Salmon says the effect of the milk and flesh of tuberculous animals on the consumers is a very grave one. "There is danger, of course. We do not know how much depends on cooking. Meat and milk of tuberculous animals does contain tuberculin. At present we do not know the exact danger. Live-stock boards must take cognizance of such diseases."

## CHAPTER XV.

### NECESSARY MEASURES FOR PROTECTION.

IT seems the unanimous verdict of the experts who have given the subject thorough study, that the disease in question can only be met by its eradication from every herd kept for the supply of food products. No inspection of these products can meet the case. Every animal must be tested, and tuberculin is the only known test upon which any reliance can be placed. Without it there is no possible guaranty for the products of the dairy.

Dr. Law says: "The sanitary officers who will affect to deal with this disease in herds without the aid of tuberculin are at best but pruning the tips of the branches of the evil tree. Public money ought not to be thrown away on such fruitless and ineffective work."

It is essential, after a stable has had all its infected animals removed and destroyed, that all cobwebs, dust, etc. should be removed from every part; the mangers, feed-boxes, drinking troughs, pails, etc. thoroughly cleansed; and the whole premises and belongings thoroughly fumigated with burning sulphur, and all wood and iron work and glass

sprayed with diluted corrosive sublimate. As has been heretofore stated, the germ of the disease is retentive of life, and only by thorough work and strong disinfectants can the purity of a stable be assured after it has once been infected.

Care should be taken also to prevent the access of untested animals to a tested herd, and no animal should be added to the herd without test. All farm animals should also be tested, and human beings suffering with tuberculosis should not be allowed to come in contact with the herd.

Every carcass designed for human consumption should be inspected, and not only the meat but all the internal organs should be proved clean. All meat supplies should be slaughtered at public abattoirs, under the inspection of a government official.

Professor Hills and Dr. Rich say: "It is questioned by some veterinarians whether for practical purposes animals very slightly affected should be considered tuberculous. Possibly they might live for years without marked advance of the disease. But who shall say in such cases when the danger line is passed? Is it worth while to prolong for a year or two the life of a few confessedly tuberculous animals and run the risk of infecting a herd as well as human beings? While many animals but slightly affected might live for years in apparent health and usefulness, a tuberculous animal, whatever its condition, is a constant menace to the other members of the herd, as well as to those who care for it or

consume its products. If to-day the germs are inactive, to-morrow they may pass into the blood, to the udder, and infect the milk. It is stated on good authority that the tubercle germs may exist in the milk even when the udder is not affected. The preservation of a single tuberculous animal invites renewed disease. There are as yet few, if any, authenticated published accounts of cured bovine tuberculosis, although possibly favorable climatic conditions may arrest the progress of the disease. Viewed solely from a monetary standpoint, the truer economy lies in the exclusion of every possible source of future infection."

Professor Walley presents the practical view in the following remarks: "In a discussion on this subject, which arose out of a paper read by me, . . . I was taken to task for not giving the members of the Association any information as to the cure of tubercle. My answer was, that I did not perceive how I was to be blamed for not devising measures for the combating of a disease which had taxed the energies and defied the efforts of many successive generations of physicians and pathologists; and, moreover, that as no practical purpose could be served by curing a tuberculous animal,—seeing that it was useless for breeding, dangerous for dairy purposes, valueless and dangerous as a companion, and its flesh noxious for human food,—I failed to perceive why time should be wasted in such an inquiry, but believed rather that all our

energies should be directed toward the prevention and eradication of the disease."

The above was written in 1879, but nothing has been developed since then to detract from the force or wisdom of Professor Walley's opinion. Much, indeed, has been learned, but it has all been in the direction of emphasizing his opinion, or of revealing the impracticability of remedial measures. It is worthy of note, also, that, even at this early date the writer recognized the fact that, even if the disease was checked for a time, its germs might later be wakened to renewed and mischievous activity.

Professor P. H. Bryce says, in a paper published in 1892: "There are in the United States forty-two thousand physicians (graduated in ten years), whose duty I assume to be to maintain the people in good health, or to heal those who are sick. What number of veterinary physicians is there, I ask, who are devoting their attention to the problem of maintaining these milk-producing animals in health, or in preventing evil results from attending the use of milk, unwholesome at the time of taking from the cow, or in its often strange and eventful history up to the time it reaches the consumer?"

After enumerating the long list of infectious diseases to which cattle are subject, he remarks: "As a rule, it is not those maladies *fulminantes*, slaying whole herds in a few weeks, that cause us alarm in the matter of milk supply, but rather those of less acute diseases, which, owing partly to ignorance,

partly to carelessness, and not infrequently to culpable cupidity, while not depriving a cow wholly of her milk-producing ability, are disseminated in milk supplies to an extent proportionate to the numerous opportunities offered and to the vulnerability of the person taking the milk."

This suggestion describes tuberculosis and illustrates its perils with great accuracy ; and Professor Bryce continues, a little later : " But as compared with other diseases, the one which must be recognized on every hand as being *par excellence* that to which sanitarians, medical health officers, and physicians must devote their attention is tuberculosis. That tuberculosis causes one seventh of all the deaths of the human race is stated by reliable statisticians ; that it prevails in almost every land is well known ; that it is disseminated everywhere on the American continent is equally well established ; and that it has greatly increased in prevalence is, unfortunately, too true. That until recent years it prevailed but little in American cattle is probable ; but that it has increased, as animals improved by in-and-in breeding have been imported for stock purposes, is well known ; and that it has been rapidly developed by the growth of dairying for the supply of milk to the enormously increased populations of our American cities has now become a well authenticated fact."

That the above was published in 1892 suggests that the present interest in the subject is not a late-

born "fad," as has been ignorantly asserted in some respectable quarters.

Professor Bryce computes that three per cent of cattle die annually from tuberculosis. This rate, in Massachusetts alone, means a loss of a little more than seven thousand animals per year. These at \$30 per head represent a net loss of \$210,000 each year. In view of such a loss now going on, the expenditure of an equal sum each year, for a few years, to practically eradicate the disease, loses something of its formidable aspect. In fact, taken in connection with the peril involved in delay or in half-way measures, liberal and prompt expenditure seems the only economical and conservative policy.

In 1889, M. Arloing, a French veterinarian, basing his computation upon statistics from public abattoirs, computed that five adult cattle in one thousand were tuberculous. The French Minister of Agriculture, in 1887, reported 8,623,441 adult cattle. M. Arloing's estimate would show, therefore, about 45,000 diseased cattle in France. Their value is estimated at \$60 each; their immediate destruction would therefore cost \$1,350,000. It should be remembered, however, that the system of inspection in the French abattoirs in 1888 and 1889 was not nearly so searching as is tuberculin, and that its use would doubtless largely increase M. Arloing's per cent, and consequently the cost to France of cleansing itself from the disease.

Dr. Kellogg records it as his firm belief, "that the wonderful development in bacteriology and physiological chemistry which the last decade has witnessed has brought to us a solution of this question; and that it only remains for sanitarians to grapple with it resolutely, and to urge upon national, state, and municipal authorities everywhere the duty of undertaking a thoroughgoing and unrelenting crusade against a disease which is annually responsible for more deaths than war, pestilence, and famine combined,—a disease which has been aptly denominated 'The Great White Plague,' and which is, in the light of modern researches, as proper a subject for public health measures, restriction, quarantine, and isolation, as small-pox, yellow-fever, or cholera."

Dr. Salmon says of the disease: "Physical examination cannot be depended upon; but a true test can be made by the use of tuberculin. We must cut loose from old methods and take tuberculin. What is needed is a tuberculin test of all animals within a certain district, followed by post-mortem examinations."

Dr. Briggs of the Health Department of New York City, in a report to the municipal authorities, says: "The high mortality from this disease in this city — over 6,000 in 1892 — is indubitable evidence of the necessity of bringing it under the sanitary surveillance of the department. The same number of cholera patients in one year would cause alarm.

The affinity of bovine tuberculosis to the same disease in the human family must not be lost sight of, because the dairy products—milk and cream as well as flesh—hold the germs giving rise to the disease; therefore not only should a system of dairy cows' milk inspection be advanced, but a more than careful examination of the dairy cows, individually, as factors of the milk, be advanced also."

Dr. Irving A. Watson, in concluding a long address on this subject, recently said: "If I were to turn for a moment from the public health side of this discussion, I would ask, What are the stock-raisers going to do with this disease? It seems to me that there is but one thing to do, and that is to turn their united efforts toward the eradication of tuberculosis in cattle, else the disease will ultimately ruin their herds, dairies, and markets for milk. The suppression of this disease is demanded from the standpoints of both the sanitarian and the farmer and stock-raiser."

Dr. Salmon says: "I know from experience that many herds of cows are entirely free from the disease. This may be proved by the history of the herds and by the tuberculin test. Now, taking such herds as a starting point, with proper precautions to prevent their infection, I believe it is quite possible to breed a race of cattle practically free from the disease; and while this is being done, the known infected herds should be destroyed. A great work like this

cannot be accomplished by an individual, nor by a single board of health. There must be co-operation, unity of effort, and the combined influence and power of the nation, the state, the local authorities, the dairymen, and all organizations that are interested."

Dr. Law, in closing his bulletin, discusses the question of who should pay the bill as follows: "The economist will object to drastic measures for the suppression of tuberculosis on the ground of expense. Who is to pay for the municipal abattoirs, the inspectorships, the disinfections, and the indemnities for slaughtered animals? In return, let me ask, Who now pays for the constant losses of live stock which the proposed system would put a stop to? for the frequent infection of sound herds by unfortunate purchases of animals that prove to be tuberculous? for the losses to the nation, to the community, and the family of the tuberculous one eighth of all deaths? for the loss of work — literary, scientific, manufacturing, commercial, domestic, and manual — of the great host of consumptives waiting all over the land to fill the places of this fatal eighth in coming mortality statistics? for the losses represented by the bills of the physician, nurse, and druggist for these invalids, and for the losses represented by the many migrations and exiles in search of health, and of the costly consumption hospitals and sanitaria? And who is to pay in the future for the needless harvest of similar

fruits which the seeds now sown through our supineness must inevitably produce in the coming generations? Is it not a truer economy to destroy the seed before it has germinated, or even before it has been sown, than to wait for the multitudinous evils that must attend on its growth and fructification?"

Dr. Theobald Smith, in Bulletin No. 7 of the Bureau of Animal Industry, writes: "As we are now entering upon an era of suppression of this disease, it should be borne in mind that radical measures are the best to begin with, and that after the disease has been weeded out of each large herd by tuberculin one or more times, such herd becomes, in a sense, an experiment in the prevention of this disease, with the element of contagion presumably completely eliminated. The future will then decide how much is to be feared from the lapses of tuberculin, from sources of the virus outside of the bovine species, and from heredity, breed, and environment as predisposing agents."

Massachusetts, which has perhaps taken a more advanced ground than any other State in attempting to control tuberculosis, is now enforcing a thorough systematic inspection and tuberculin test of all the neat cattle in the State. The Cattle Commission, in their report for 1894, explain their adoption of this course as follows:—

"At the time of the adoption of the tuberculin test as the proper method of examining all animals

suspected of being tuberculous, the Board were of the opinion that, while its efforts in this direction as based upon the mere examination of animals reported by the inspectors to be tuberculous at isolated points throughout the State would result in the destruction of actually diseased animals to a considerable extent, it would be of but little service in really cleansing the herds of the State from the disease, because the animals so examined and selected for the test were only such as appeared to show external symptoms of the disease; and also because the Board felt, from its experience with the test, that other animals, apparently healthy, were being allowed to go free and spread the contagion. Thus in the end the percentage of diseased animals would be but slightly decreased.

“They were further impressed with the fact that not only were the public interested in the destruction of diseased animals, but the farmers and dairy-men were equally interested in having, if possible, some means of assisting them in their purchase of cattle, so that they might be able to replace the animals destroyed with others which had successfully passed the test. The Board therefore felt that the best method of protecting all parties and eradicating the disease was only to be obtained by a thorough scientific examination of all neat stock throughout the State. They therefore decided to begin a systematic examination of all animals in the State, county by county; taking proper precaution, as

fast as all the animals in each county had been examined, destroyed, or marked, to prevent, by quarantine regulations, the importation within its limits of animals which had not already been so examined."

Dr. Niles, veterinarian of the Virginia Experiment Station, recommends the following as necessary to control the disease in the lower animals and lessen the mortality in man: "The establishment of a State Board of Health with one member a veterinarian; a liberal State appropriation; the establishment of public abattoirs, where all food animals must be slaughtered; veterinary inspection of all meats, and of all public dairies; compensation for condemned animals; power to the veterinarian to destroy diseased animals; country hospitals for indigent tuberculous people; compulsory disinfection of all premises occupied by tuberculous people or animals; cremation of all diseased carcasses, and prohibition of tuberculous people from attending public gatherings in closed buildings."

The New York Commission, in their report of 1895, say: —

"Tuberculous cattle are valuable to the State only when dead; and inspection and confiscation could never be detrimental to the interests of the honest dairymen, especially if liberal compensation were granted, under well defined conditions. It is therefore necessary that there should be some regular inspection of cattle in order that any affected should

be eliminated from the milk supply. These should at once be destroyed, as both their flesh and milk are unfit for food. There should be devised some central authority, conformably to the genius of our government, with authority to exercise continuous inspection in this line; for, as will be seen from the investigations of this Commission, this is not a work to be taken up in a season and afterward laid aside. There should be some supervision of our meat and milk supply.

“The object lessons given by this Commission have been of incalculable benefit to the people in the work of disseminating knowledge concerning the behavior of the disease, and many dairymen are now engaged in examining their own cattle. The stamping out policy can now be put into action by rigorous inspection, first directed in the distributing centres and milk supplies of municipalities, and dairies supplying milk to cheese factories, creameries, and condensories, after which examination should extend to more remote districts. Such action would be speedily followed by the complete extinction of the disease. The question is one of political economy in the improvement of the dairy interests and the betterment of public health. While it is admitted that this work will involve a large expenditure, ultimate gain to the agriculturists and to the saving of human life will be beyond estimation.”

Dr. Salmon says: “If we start out practically to

get rid of tuberculosis, the first proceeding would be to educate the public in regard to it. We want the public and the dairymen to understand the importance of the subject, and to co-operate with us. If they did this, and were willing to annihilate a herd when they found tuberculosis, and disinfect the stables a little while before putting new cows on the premises, and then bought new animals from a healthy herd, we might accomplish much. I am rather of the opinion that in a great many cases it would be best to establish herds separate from the disease; and by care these herds might be kept free from it indefinitely. Of course, there would be some objections to undertaking such a step; but I have great hopes, because I feel sure there are a large number of herds in which the disease has never been introduced. Therefore I think that in connection with the sanitary work by officials there should be educational work going on, and endeavors by the dairymen themselves to establish herds which are free from the disease. Then, in addition to the work as it is carried on, there must be a co-operation of everybody interested. As I look at the matter, there is very little use for any one individual or any one State to start out on a crusade of this sort, and expect it to result in success. There must be co-operation between the different State Boards of Health and the national government; and we must try to co-operate with the dairymen themselves, and the dairy associa-

tions must take action in the matter. We must do everything we can to sustain the hands of the inspectors."

Professor Pearson writes in a recent paper :—

" By the use of tuberculin it is possible to isolate the diseased animals, and make sure that those remaining are free from tuberculosis. If the stable is now disinfected, and the herd retested after an interval of six months to find cases that might by some almost impossible chance have escaped the first examination, we should have freed the herd from tuberculosis ; and it would then only remain to exclude diseased additions to keep clear of the scourge.

" An important question that presents itself is, What shall be done with the cows that react ? Our previous experience and present knowledge allow but one answer to this question ; and it is, *Destroy them !* All animals that react, ignoring the very few possible exceptions, are tuberculous ; but it should be remembered that some of them suffer to but a very slight degree. In some of the animals we may, upon making the autopsy, find nothing but a few tuberculous areas of the size of a pea, and perhaps these are situated in the lymph glands. In such a condition an animal cannot scatter the tubercle bacilli, and it might be objected that slaughter is unnecessary waste. But how are we to know that the tubercles, which we are sure exist in the body, are not in the lungs, the kidneys, the

sexual organs, or even the udder? The most careful and exact physical examination could easily fail to elicit their presence at some stages of their growth.

“ We know that nearly all cases of tuberculosis in cattle tend to advance, and that a slight depression or illness may lead to the rapid development of a more general tuberculous condition, starting from the lesion which we know is present. The sale of an animal known to have tuberculosis, though ever so slightly, cannot be justified either morally or legally; and to keep such an animal in a herd is to harbor a foe of unknown strength.”

In a recent bulletin of the United States Bureau of Animal Industry, the necessity of absolute disinfection of premises where tuberculosis has been discovered is insisted on. Corrosive sublimate (mercurial chloride) is recommended,—an ounce to eight gallons of water, to be dissolved for twenty-four hours in wooden vessels, and to be applied freely as a wash in all parts of the stable. As this is a very poisonous preparation, it should be carefully guarded. All dirt should be removed before the wash is used, and afterward the stable should be kept vacant as long as possible. Before animals are put in, all the parts they would be likely to touch with their tongues should be washed with clean water. Chloride of lime, five ounces to a gallon of water, may be similarly used.

A serviceable disinfectant, that is quite corro-

sive but not poisonous, is crude carbolic acid, two quarts, and crude sulphuric acid, two quarts. Mix these in wood or glass vessels, slowly adding the sulphuric to the carbolic acid. As considerable heat is evolved in mixing, the power of the mixture is retained by keeping it in cold water while mixing. It should be diluted one part to twenty of water, and generously applied, care being taken to avoid splashing the hands of the operator.

Whitewash is not strong enough to destroy the bacilli; but if applied after the stalls are thoroughly washed, it will imprison them so as to render at least temporary protection.

The stanchions, feed-boxes, and halters, and the walls, ceilings, and windows of stables should be frequently cleansed and disinfected, even where the presence of the disease is not suspected. The frequent removal of the manure, flushing of the runs behind the cattle, and good ventilation, are all aids to health.

Cattle should have plenty of room, with at least six hundred cubic feet of air space to each animal. Each animal should always occupy the same place, otherwise one diseased animal may soon infect a whole stable. Stables should also be protected from the expectorations of human beings affected with pulmonary tuberculosis.

The Massachusetts Veterinary Association has also recently given this subject careful consideration, and through a committee it has issued rec-

ommendations including the following. Farmers should, as far as possible, raise their own stock, breeding only from animals of strong constitution and known freedom from tuberculous taint; each farmer should own a bull, and restrict its use to his own herd, except where he is sure of the purity of his neighbors' herds; allow no strange animal to approach the herd; never buy from a suspected herd; never buy an animal with a cough, bad breathing, lumpy or diseased udder, swollen joints, or with a tendency to scour or bloat; give each animal at least one thousand cubic feet of air space; provide constant ventilation without exposing the animals to cold drafts; give abundant outdoor exercise, except in extreme weather; keep the barns clean, and sprinkle always before sweeping; exclude consumptive people from the barns; keep no manure in the cellar or near the cattle; have the cellar well drained, lighted, and ventilated; allow no accumulation of water or filth in the barn-yard; avoid early, late, and too frequent breeding, and excessive feeding and milking.

To eradicate the disease where present, they advise the test of all animals by tuberculin, followed by immediate slaughter of all detected animals, frequent retests, and the most thorough disinfection of the stables and their surroundings.

The International Veterinary Congress at Brussels, in September, 1883, now twelve years ago, after a discussion of the subject, adopted resolutions which are thus summarized by Dr. Fleming:—

“1. In order that the flesh and viscera of the animal be allowed for consumption, the disease should only be in its earliest stage, the lesions confined to a small portion of the body, the lymphatic glands yet free from alteration of a tuberculous character, the tuberculous centres not softened, the meat healthy and of the first quality, and the general nutrition of the animal at the time of slaughter leaving nothing to be desired.

“2. The flesh of tuberculous animals intended for food should not be conveyed beyond the locality in which slaughter has been effected, nor offered for sale at the stall of an ordinary butcher.

“3. Every quarter of meat, and any viscera showing tuberculous lesions or transformations, as well as the flesh of every animal in which signs of more advanced tubercular infection are found than those above mentioned, should be rendered unsalable by sprinkling them with petroleum, and finally buried, under the surveillance of the police. The extraction of the tallow by boiling, as well as the sale of the skin, may be permitted.

“4. The inspection of every animal affected with tuberculosis should be made by a veterinary surgeon, who alone can judge whether the flesh may be consumed.

“5. The milk of animals affected with or suspected of tuberculosis should not be used for the food of man, nor yet of certain animals, and its sale should be rigorously prohibited.”

The International Veterinary Congress at Paris, in 1888, after a prolonged discussion in which the safety of mildly tuberculous meat was fully advocated, resolved that "there is need to carry out by every possible means, including compensation to those concerned, the general principle of seizure and total destruction of all the flesh derived from tuberculous animals, no matter what number of specific lesions may be found in them."

The International Veterinary Congress of 1889 devoted considerable of its time to this subject, and Professor Arloing formulated its expression as follows: "That it is necessary to eliminate from human and animal consumption the flesh from tuberculous animals, mammals, and birds, whatever may be the degree of tuberculosis or the apparent qualities of the meat. That the skin and horns may be utilized after disinfection, and also the fat if need be. That the milk of tuberculous cows should not be allowed for human alimentation. That dairies in large towns or their vicinity should be properly inspected. That everything should be done to insure the boiling of milk from unknown sources before it is consumed."

Professor Arloing concluded his address, presenting the above conclusions, with this expression: "We shall always gain in combating, no matter at what cost in money, an enemy so redoubtable as the virus of tuberculosis."

The United States Veterinary Medical Association in 1889 took action as follows:—

“ Whereas, we, the members of the United States Veterinary Medical Association, being sensible of the prevalence of bovine tuberculosis in the United States, particularly in the dairy stock of the Eastern States, it being computed that at least from ten to fifteen per cent are so affected in one form or another, being satisfied of its infectious and contagious character, and of its identity with tuberculosis or consumption in the human family, that it can be conveyed to others by inoculation and ingestion, and believing that a large percentage of this disease in mankind can be traced to this source,—

“ *Resolved*, That we strongly condemn the use of the milk or flesh of animals so affected, in any form, as an article of diet.

“ *Resolved*, That this Association urgently protests against the employment of empirics as meat or dairy inspectors; that such duties should be confined to duly qualified veterinarians having a comprehensive knowledge of comparative pathology.

“ *Resolved*, That the inspection of meat can only be properly conducted at the abattoirs.

“ *Resolved*, That all dairies should be periodically visited, the cows carefully examined, and their condition reported upon to the local authorities.

“ *Resolved*, That a committee of three be appointed by the chair to place these resolutions before the Secretary of Agriculture, so that national measures may be adopted by which this disease can be placed under the same category as contagious pleuro-pneumonia, and be similarly dealt with.”

Of infectious diseases in general Dr. Salmon says: "These diseases are not, as a rule, amenable to treatment. When the symptoms have once appeared, the disease is apt to run its course in spite of treatment; and if it is one from which animals usually recover, all that can be done is to put them into the most favorable surroundings. Many infectious diseases lead sooner or later to death, and treatment is useless so far as the sick are concerned. But it may be worse than useless for those not yet infected. All animals suffering with infectious diseases are a menace to all others, more or less directly. They represent for the time being manufactories of disease germs, and are giving them off more or less abundantly during all the period of disease. They may infect others directly, or they may scatter the virus about, and the surroundings may become a future source of infection for healthy animals. . . . When an infectious disease has gained foothold in a herd, the course to be pursued in getting rid of it will depend upon the nature of the malady. A good rule is to kill diseased animals, especially when the disease is likely to run a chronic course, as in tuberculosis."

H. F. Vickery, M. D., of Boston, says the present awakening about tuberculosis fills him with enthusiasm. "It is a welcome thought that we are on the threshold of a great diminution in the scourge; and I cherish the hope that the work which is being begun will in the course of the next two or three

generations very greatly diminish the prevalence of tuberculosis. If what we now believe is true, and the efforts which we are to encourage are carried out persistently for a few generations, this omnipresent germ will no longer be ready to enter every weak human system ; and the results of what we do now will be increasing in a geometrical ratio, not only for ten years or for twenty, but for fifty."

In relation to the question of the discussion causing alarm, he says: "Needless alarm should be deprecated ; but if we can throttle a disease which is killing from a seventh to a fifth of all who die, is it not well to excite the apprehensions of the public ? I should be glad to do it everywhere I could."

Of the prevention of human infection Dr. Henry Mitchell, of Trenton, N. J., writes : —

" All tuberculous discharges should be destroyed before they become dry. Sputa should be received upon pieces of cloth and burned ; or they should be discharged into cups containing a little of a saturated (five per cent) solution of carbolic acid. In the street, and when travelling in public conveyances, a pocket cup should be carried to receive the expectorated material. No such receptacle should be emptied until boiling water has first been poured upon its contents. The water should be allowed to cool in the cup.

" The consumptive patient may reinfect himself by swallowing some of the tuberculous matter from

his lungs, and thus cause the disease to attack one of the abdominal organs; or by failing to destroy the sputa he may permit the infection of the dust of his apartment, and by inhaling the germs plant the disease anew in some previously healthy portion of his lungs. Meat and milk known to be from diseased animals should be rejected. Milk from a doubtful source may be sterilized by boiling.

“ Carpets cannot be kept clean, and they are almost certain to become lodging places for tubercle bacilli in houses occupied by consumptive patients. Rugs, which are not permanently fastened, are preferable to carpets. They should be frequently carried out of doors and exposed all day to air and light. Carpets, rugs, and floors which are believed to be infected should not be swept when dry. Dust should be removed from the furniture by wiping with a damp cloth, and the cloth should be burned at once.

“ No healthy person should sleep in a room occupied by a consumptive. Rooms vacated by persons having consumption should be disinfected by the application of corrosive sublimate (1 to 1,000) to the side-walls, doors, and all wood-work, including floors and furniture. This solution is poisonous. All wood-work should therefore be washed with soap and water. Dishes, knives, forks, and spoons used by a consumptive should be scalded after use. All other infected articles should be subjected to a

temperature of not less than 212 degrees Fahr., for thirty minutes, or they should be destroyed."

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The matter here presented does not by any means exhaust the material at hand ; but it is sufficient to impress the patient reader with the gravity of the situation, both as it affects cattle owners and the general consumers of cattle products. The question of the control or the extirpation of the disease is a vital one. Massachusetts is among the first of the States to take radical legislative action on it, and her course will be watched with great interest by the whole country. The other New England States are moving substantially on Massachusetts lines, and everywhere, where cattle are kept for dairy use, the questions considered in this volume are among the most interesting and important now before the public.

The testimony herewith presented proves that the matter is not merely one of interest to the small circle of professional men, nor to those engaged in the production of meat and dairy products ; but it involves the health, the happiness, and the life of the great public, — the consumers. These are hardly yet aware of their own deep concern in the matter ; but its discussion, and the consideration of relief measures, now so widely begun, will continue until the whole civilized world gives it attention.

## N O T E.

JUST as the forms are closing on these pages another feature of interest is appearing, not directly related to the subject treated here, but so connected as to justify its mention. This is the announced discovery that the inhalation of the odor of peppermint is a cure for pulmonary tuberculosis in the human family. The matter has been under careful and extended experiment by Dr. G. W. Carosso, at the military hospital at Genoa, Italy, and he reports success with about three quarters of the cases treated. It has also had limited trial in this country. The treatment requires almost constant inhalation, and is probably applicable only to cases of pulmonary affection. For these and other practical reasons it does not seem probable that the treatment will be of value with cattle.

THE END.













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